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Volume LXII April-May 1997

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Page 510	for *Peziza institia*	read *Peziza insititia*

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THE HELVELLACEAE: SYSTEMATIC REVISION AND OCCURRENCE IN NORTHERN AND NORTHWESTERN NORTH AMERICA

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Abstract

Epigeous genera of the Helvellaceae (Pezizales, Ascomycota) are separated into tribes Helvelleae and Gyromitreae on the basis of excipulum structure, while hypogeous genera are included as *incertae sedis* at the tribe level. Ornamentation of ascospores (SEM) is valuable in the delimitation of genera, subgenera, and species. New subgenera proposed are *Gyromitra* subgenus *Melaleucoides subgen. nov.*, with warted, nonapiculate, biguttulate ascospores; *Gyromitra* subgenus *Caroliniana subgen. nov.*, with coarsely reticulate ascospores with multiple spicules at the poles; *Helvella* subgenus *Cupuliformae subgen. nov.*, with regularly cupulate apothecia, solid terete stipes, and broadly ellipsoidal, finely rugose ascospores; and *Hydnotrya* subgenus *Cerebriformae subgen. nov.*, with globose, echinate ascospores. *Gyromitra* subgenus *Discina* is emended. New combinations include *Helvella* subgenus *Leucomelaenae comb. nov*, *Helvella* subgenus *Silvicolae comb. nov.*, *Helvella* subgenus *Macropodes comb. nov.*, and *Helvella* subgenus *Elasticae comb. nov.* Epigeous taxa and hypogeous taxa with chambered ascocarps were studied in detail. Collections of 44 species in six genera (*Gyromitra*, *Rhizina*, *Pseudorhizina*, *Helvella*, *Underwoodia*, and *Hydnotrya*) from northern and northwestern North America are described. One extralimital genus (*Gymnohydnotrya*) and 15 species outside the study area are included with systematic notes. The known geographic range for many species is extended and there are several new records for North America (*Helvella rivularis*, *H. verruculosa*, *H. unicolor*). Maps and keys for taxa in northern and northwestern North America are provided.

Keywords: Ascomycete systematics, Pezizales, Helvellaceae, *Gyromitra, Pseudorhizina, Rhizina, Helvella, Underwoodia, Hydnotrya, Gymnohydnotrya*

Introduction

The Helvellaceae comprise a diverse array of macroscopic discomycetes. The family has a global distribution but reaches its peak of diversity in northern temperate regions. Apothecia vary from simple cupulate to complex, lobed or convoluted and may be sessile or stipitate. Some attain considerable size, being among the largest fruiting bodies produced by ascomycetes of any kind (e.g., the "false morels" *Gyromitra gigas, G. esculenta*). Some species are mycorrhizal, while others are saprophytic or parasitic. Saprophytic species occur on a variety of substrata including soil, coniferous and deciduous litter, and rotted wood. *Rhizina undulata* is a serious pathogen of conifer seedlings in northwestern North America.

This monograph focuses on epigeous taxa and hypogeous taxa with chambered ascocarps (except *Barssia* linked to Helvellaceae by Kimbrough *et al.* 1996) of northern and northwestern North America and presents a comprehensive family outline (Table 1). Taxa with a solid or veined ascocarp interior were not considered in detail due to the limitations of the project.

Family characters were reviewed by Dissing (1972) and Harmaja (1969a, 1974a, 1976b), and have been discussed briefly in comprehensive works on Pezizales (Eckblad 1968; Korf 1972, 1973a; Trappe 1979). Monographs have focussed on genera (e.g., Dissing 1966b; Weber 1972; Zhang and Minter 1989b), have treated the genera in a more restricted sense than accepted here (McKnight 1969; Kempton and Wells 1973), or have considered only a selection of species within a genus (e.g., McKnight 1971, 1973; Harmaja 1969b, 1977a, b, 1979a, b).

While literature concerning the Helvellaceae in North America is abundant (e.g., Weber 1972, 1975; McKnight 1969, 1971, 1973; Kempton and Wells 1970, 1973; Ginns 1968, 1974a, b, c, d, e, 1975; Abbott and Currah 1988; Callan 1990; Anderson and Ickis 1921; Pfister 1980; Seaver 1921; Morse 1945; Kanouse 1946; Groves and Hoare 1953; Dissing and Lange 1967; Harmaja 1981; Gilkey 1916, 1939, 1947, 1954), only a few authors have concentrated on material from the arctic, coastal, boreal, montane, and alpine regions in our study area (Kempton and Wells 1970, 1973; Abbott and Currah 1988; Weber 1975). Additional reports occur in floristic accounts from the area (e.g., Larsen and Denison 1978; Abbott and Currah 1989; Currah *et al.* 1989; Schalkwyk 1977; Snyder 1936; Kanouse 1947; Hawker 1968b; Cummins 1930; Zeller 1927; Fogel and Trappe 1976; Fogel 1976; Groves and Hoare 1954; Huhtinen 1984; Hutchison *et al.* 1988) or in collections listed in broader taxonomic treatments dealing primarily with restricted groups of taxa and often extralimital material (e.g., Pfister 1980; Gilkey 1947; Harmaja 1979a; Ginns 1974a, b, c; McKnight 1969, 1971; Seaver 1921, 1928, 1942; Morse 1945; Kanouse 1949).

'*Elvela*' (=*Helvella*, orthographic variant) was erected by Linnaeus in 1753 to accommodate *Elvela mitra* (=*Helvella crispa* of Fries, 1823). Linnaeus cited P.A. Micheli, 1729, Nova Plantarum Genera 204, Tab. 86, Fig. 7 (=*H. crispa*) and Valliant, 1727, Botanicon Parisienne 57, Pl. 13, Fig. 1 (=*H. acetabulum*), the earliest records of species from this family. The Elvellaceae were established by Fries in 1823 and later published as Helvellaceae by Dumortier in 1829 and Corda in 1842. Fries restricted the family to stipitate taxa including *Morchella* and *Leotia*. Taxa treated by Fries (1821-1832, Systema Mycologicum) are sanctioned under the International Code of Botanical Nomenclature (ICBN Articles 13.1 and 15.1; Greuter *et al.* 1994) and established names for two genera (*Helvella* and *Rhizina*) as well as epithets for *Helvella crispa, H. lacunosa, H. acetabulum, H. macropus, H. atra, H. pezizoides, H. elastica, Gyromitra esculenta, G. infula, G. caroliniana, G. perlata,* and *Rhizina undulata*. Although Fries distributed these species among *Helvella*, *Morchella*, *Rhizina*, and *Peziza*, he clearly recognized the affinities among these various species. The first three genera were placed in his broadly conceived Elvellaceae, with the cupulate forms in the tribe Helvelloideæ of the Pezizaceae where affinity with *Helvella* and *Rhizina* was noted. Many taxa included by Fries originated in the earlier works of Linnaeus (1753), Schaeffer (1762-1774), Scopoli (1772), Afzelius (1783), Bulliard (1780-1798), Persoon (1796, 1800), Holmskjøld (1790), and Bosc (1811).

Gyromitra and *Helvella* were considered separate genera by Fries in 1849 although this was not universally accepted (e.g., Seaver 1928; Kanouse 1946). Quélet (1873), Cooke (1878), and Gillet (1879) adopted the two genus concept for these taxa. Fries (1849) also separated the cupulate species of *Gyromitra* from *Peziza* placing them in the genus *Discina*. Quélet (1873) and Bresadola (1881-1900) still retained many cupulate taxa in the genus *Peziza.*

Another classification was proposed by Boudier (1885, 1907) and was based, in part, on earlier works of Fries (1849) and Fuckel (1869). Three of Boudier's ten genera (Boudier 1907), namely *Helvella*, *Gyromitra*, and *Rhizina*, are used here while the others at least reinforce the recognition of taxa we have defined as subgenera. In *Helvella*, we include Boudier's *Helvella*, *Leptopodia*, *Cyathipodia*, *Acetabula*, *Macropodia*, and *Wynnella*. The genus *Gyromitra* includes *Gyromitra*, *Physomitra*, and *Discina*. *Rhizina* was accepted as monotypic by Boudier in agreement with the concept of Fries (1823). Boudier's genus names which embody a narrow concept of genera defined on the basis of ascomatal morphology are used by both Dennis (1981) and Breitenbach and Kränzlin (1981).

A broader approach was initiated by Quélet in 1886 and later supported by Nannfeldt (1937, see below) who felt that variation in ascocarp morphology was too substantial to be considered a feature of taxonomic value at the generic level. Broad generic concepts have been adopted by many recent authors including Dissing (1966b), Weber (1972), Harmaja (1969a, 1974a), and Kimbrough *et al.* (1990).

The remaining epigeous genera of Helvellaceae include *Underwoodia*, established by Peck in 1890, and *Pseudorhizina*, erected by Jacevskij in 1913.

The affinity of indehiscent hypogeous taxa, many considered Tuberales *sensu* Korf (1973a), to the Helvellaceae was suggested by Trappe (1979). Genera which have been allied to the Helvellaceae include: *Choiromyces* and *Balsamia* described in 1831 by Vittadini; *Hydnotrya*, described in 1846 by Berkeley and Broome; *Barssia* described by Gilkey in 1925; *Fischerula* described in 1928 by Mattirolo; *Dingleya* described in 1979 by Trappe; *Cazia* described in 1989 by Trappe; *Gymnohydnotrya* described in 1989 by Zhang and Minter.

The concept of the Helvellaceae accepted by us, is founded on the concept outlined by Nannfeldt (1937) who considered the unique tetranucleate spores a unifying feature in the family. Ascospores also have oil reserves, visible as large guttules (lipid droplets *fide* Gibson and Kimbrough 1988a, b; Kimbrough *et al.* 1990). This concept has been adopted by Dissing (1966b), Harmaja (1976b), Korf (1972), Kimbrough (1970, 1991), and Eriksson and Hawksworth (1993). Kimbrough and others (Gibson and Kimbrough 1988a, b; Kimbrough and Gibson 1989; Kimbrough *et al.* 1990; Kimbrough 1991) have illustrated the uniformity of ascospore ontogeny and septal structures among epigeous taxa of the Helvellaceae.

Tetranucleate ascospores support the inclusion of the hypogeous taxa *Hydnotrya*, *Gymnohydnotrya*, *Choiromyces, Barssia*, and *Balsamia* (Berthet 1982; Zhang and Minter 1989a, b; Eriksson and Hawksworth 1989, Zhang 1991; Kimbrough *et al.* 1996, Donadini 1986b). *Cazia, Fischerula,* and *Dingleya* were considered possible members of the Helvellaceae based on morphological grounds (Trappe 1975b, 1979, 1989), but recent investigations have excluded them from the family (Trappe *et al.* 1992; Trappe pers. comm.).

Materials and methods

The study region includes arctic, coastal, boreal, parkland, prairie, montane, and alpine areas of northwestern North America. The boundaries encompass Yukon Territory (YT), Northwest Territories (NWT), British Columbia (BC), Alberta (AB), Saskatchewan (SK), Manitoba (MB), Alaska (AK), Washington (WA), Idaho (ID), Montana (MT), Oregon (OR), and Wyoming (WY). Collections were made at boreal, parkland, montane, and alpine sites in the interior northwest (Alberta, British Columbia, Yukon).

Over 2,500 specimens were examined and included collections from within the study area, type material and selected extralimital collections. New collections were made during 1987-1996. Most were photographed *in situ* using Kodacolor 400 ASA film but some were photographed in the laboratory using a copy stand with Ektachrome 100 ASA film. Macroscopic features of fresh specimens were described within six hours of collection. Specimens were air dried and packaged with dichlorobenzene crystals in plastic bags and then boxed. Macroscopic observations and measurements reported here were from dried material except where noted. Herbarium material was supplied by ALTA, BPI, C, CFB, CUP, DAOM, DAVFP, H, IMI, K, L, MICH, MU, NY, NYS, O, OULU, PC, PRC, S, TRTC, TUR, UAMH, UBC, UPS, UVIC, WIN, WSP, and WTU (acronyms follow Holmgren *et al.* 1981, Index Herbariorum). In addition, material was obtained from the private herbaria of Abbott (SA), Danielson (RMD), Wells and Kempton (WK), and Kristiansen (RK). The Danielson collections and the majority of Abbott collections are now deposited in ALTA; a few specimens from the Abbott collection are deposited in UAMH and K. Collections at OSC and MICH from within the study area were not examined due to constraints in time and resources.

Microscopic details of the hymenium and ascospores were observed from dried material rehydrated in distilled water. Squash mounts in distilled water were used primarily, but some additional mounts were made in 5% KOH, Melzer's reagent (Groves 1962), or lactophenol Cotton Blue (distilled water 20 ml, lactic acid 20 ml, phenol crystals 20 g, Cotton Blue 0.05 g, glycerol 40 ml). Measurements were taken with an ocular micrometer using distilled water mounts and an Olympus bright-field light microscope. Spore measurements are of mature spores including all ornamentation, and spores of unusually small or large size are in parentheses. Apothecial cross-sections were made with a freezing microtome and mounted in distilled water. De Barry bubbles were observed in KOH, Melzer's Reagent or lactophenol Cotton Blue mounts. Ascospore nuclei were stained via the Feulgen reaction with Schiff's reagent (Östergren and Heneen 1962).

SEM observations of ascospores were made using air-dried fragments of apothecia mounted with a double sided adhesive. A double coating of gold-paladium, applied with a Nanotech sputter coater, was the only pretreatment used before specimens were examined and photographed with a Cambridge S-250 SEM. Only ascospores which had been ejected and were adhering to the excipular surface were examined, except for *Hydnotrya* for which apothecial tissue was crushed to liberate or expose the ascospores. Observations of hymenium and excipulum used fresh apothecial tissue fixed in 4% glutaraldehyde in 0.07 M sodium phosphate buffer, rinsed in buffer, and postfixed in buffered osmium tetroxide. Tissue was dehydrated in a graded series of acetone from 70 to 100%, placed in a 1:1 ratio solution of acetone:Peldri II for one hour, and then immersed in 100% Peldri II for another hour before drying (Kennedy *et al.* 1989).

Culturing of some species was attempted by placing tissue explants and/or ascospores on agar media and incubating at room temperature (20-24°C). Media included Potato Dextrose Agar (PDA; Difco), Phytone Yeast Extract agar (PYE; Difco), Nobles' Malt Agar (NMA; 12.5 g malt extract, 20 g agar, 1000 ml water), and Cornmeal Agar (CMA; Difco), with and without antibiotics and/or chalk. Cultures are deposited in UAMH.

Characters and their use in systematics

Delimitation of the taxa of the Helvellaceae requires consideration of both macroscopic and microscopic characters. Some of these may vary in importance among taxa and suites of characters may differ from taxon to taxon depending on which characters show the most stability. The following is an assessment of the usefulness of traditional features such as fruitbody size, shape, colour, etc., microscopic characters, and an evaluation of the taxonomic potential of more recent data from scanning electron microscopy.

Macroscopic characters (Figs. 1-17). Apothecial size varies from a few millimetres in some species of *Helvella* (e.g., *H. rivularis*)(Fig. 10) to 20 cm in species of *Gyromitra* (e.g., *G. esculenta*) and *Pseudorhizina* (e.g., *P. californica*)(Fig. 13).

The shape of the apothecium has often been used for taxonomic purposes, but delimitation of genera and species should allow for considerable variation. For example, cupulate species (Figs. 2b-c, 3a-e, 9-11) were placed in separate genera from those with auriculoid (erect, elongate, one-sided apothecia reminiscent of a rabbit's ear)(Fig. 4b-c) or irregularly lobed apothecia (Fig. 1a-b, 2a, 6-8, 13, 14). However, there is a morphological gradation from simple cupulate forms to species with more elaborately folded or convoluted and reflexed apothecia. Species in the genera *Helvella*, *Gyromitra*, and *Pseudorhizina* may have saddle-shaped or bilobate (Fig. 8) apothecia. These species also exhibit simple convex, trilobate, or irregularly lobed apothecia, often in the same collection with bilobate forms. Auriculoid apothecia are known in only one species (*Helvella silvicola*)(Fig. 4), but strongly one-sided cupulate forms are also known in other members of the genus (e.g., *H. leucomelaena*).

The apothecial margin is also useful for distinguishing among species. In *Helvella*, the margin can be strongly inrolled over the hymenium when immature and gradually expands with age (e.g., *H. maculata, H. compressa, H. crispa*)(Figs. 6, 7). In contrast, *H. lacunosa* and *H. elastica* are reflexed towards the stipe when young (Figs. 5b, 8) and often become fused to the stipe at maturity. Margin characters are not significant at the subgenus level in *Helvella* (see the sections of Dissing 1966b and Weber 1972). There is a gradation from inrolled to reflexed in several groups of related species (i.e., from strongly inrolled to incurved to reflexed in the *H. compressa, H. albella, H. elastica* group, and the *H. crispa, H. fusca, H. lacunosa* group). Species of *Gyromitra* are similar, with the cupulate species (e.g., *G. perlata*) typically having a strongly inrolled margin initially (Fig. 2c), while stipitate species (e.g., *G. infula*) always have a reflexed apothecial margin (Fig. 1) typically ingrown with stipe tissue. *Rhizina* is similar to sessile cupulate members of *Gyromitra*, but the apothecium is sessile and discoid or somewhat irregular at all stages. It is unique in its indeterminate marginal growth and rhizoid-like excipular projections. *Pseudorhizina* species always have a strongly reflexed apothecial margin which initially is rolled over the excipular surface on the underside of the apothecium (Figs. 13, 14). The margin typically remains free. Species of *Underwoodia* are unique in that the apothecium is fused over the entire surface to the apical region of the stipe (Fig. 12). Fusion may occur in *Helvella* and *Gyromitra* (e.g., *H. lacunosa, G. esculenta*), but only at intervals along the apothecial margin. In *Hydnotrya*, the sessile ascocarp is initially a subglobose or sparingly infolded structure with the hymenium lining the internal surface (Fig. 17). As development continues, the ascocarp becomes highly infolded creating numerous internal chambers (Fig. 16). The margin in species of *Hydnotrya* is often entirely fused to form an enclosed fruiting body at maturity, but may be only partially fused at the base of the ascocarp in immature stages.

The hymenium may be smooth, undulate-rugose, or strongly convoluted-rugose. Cupulate species of *Helvella* and *Gyromitra* are typically smooth (Figs. 2b, 3a, 4, 9, 10), especially when young (e.g., *H. chinensis, G. olympiana*), but most species slightly to strongly are undulate-rugose at maturity (Figs. 1, 2a, 5-8, 13, 14), and a few species in *Gyromitra* (e.g., *G. esculenta*) are strongly convoluted-rugose.

The excipular surface is typically smooth (Figs. 2b, 3a, 4a, 9), but may have distinct ribs continuous with those of the stipe (Figs. 3e, 11, 14b). The presence and degree of ribbing on the excipular surface is of taxonomic value at the species level.

Apothecia may be sessile, subsessile, or prominently stipitate. *Helvella* and *Gyromitra* contain both sessile and stipitate forms. This feature has been used to subdivide these taxa into several genera, but like apothecial shape, this feature also shows a progression from sessile through subsessile or indistinctly stipitate to distinctly stipitate and is not useful for generic delimitation (Harmaja 1969a; Donadini 1983). Stipe development is relatively constant within species, but some taxa (e.g., *H. leucomelaena*) may vary from subsessile to short stipitate, even within a single collection. Stipes of *Helvella* may be slender and terete (e.g., *H. macropus, H. elastica*)(Figs. 5b-c, 9), sulcate, fluted or ribbed (e.g., *H. solitaria, H. leucomelaena*)(Fig. 3a-b), or highly ribbed with anastomosis between ribs (e.g., *H. crispa, H. costifera*)(Figs. 3e, 8). Internal stipe construction may be solid (e.g., *H. corium, H. verruculosa*), hollow (e.g., *H. elastica*), or highly chambered (e.g., *H. crispa, H. lacunosa*). These features are generally constant within species, but may vary. For example, *H. solitaria* usually has a sparingly ribbed, solid stipe, but some are only slightly fluted while others are highly ribbed with occasional anastomosis between ribs and may have a few internal chambers. Stipitate species of *Gyromitra* have stipes which are infolded or less frequently terete (Fig. 1a), and are internally solid or chambered. *Pseudorhizina* species are prominently stipitate with strongly ribbed, solid or chambered stipes (Figs. 13, 14). *Underwoodia* stipes are prominently ribbed and chambered (Fig. 12). *Hydnotrya* species are sessile (Figs. 15-17).

Most members of the Helvellaceae are shades of grey and brown. In *Helvella*, hymenia are white (e.g., *H. lactea, H. crispa*)(Fig. 6) to black (e.g., *H. corium, H. atra*)(Fig. 5a, 8). Reddish browns occur in several species of *Gyromitra (G. esculenta), Helvella (H. silvicola),* and *Hydnotrya* (*H. tulasnei*). Bright yellow brown or orange brown pigmentation is seen in some members of *Gyromitra* (e.g., *G. leucoxantha*) and *Hydnotrya* (e.g., *H. variiformis*). Excipular pigmentation is frequently paler than the hymenium (Fig. 2b, 7). White to cream excipular surfaces are common in *Helvella, Gyromitra, Pseudorhizina,* and *Rhizina*. The stipe is concolourous with the excipular surface, or paler, with the basal region usually white or pallid. Some species of *Gyromitra* (e.g., *G. ambigua, G. esculenta*) and species of *Pseudorhizina* have purplish red tints on the stipe. A mottled hymenium is evident in some specimens (e.g., *Helvella maculata, Gyromitra esculenta*), but is not diagnostic.

Vestiture (or lack thereof) on the excipular surface and stipe varies with development and between collections, but is constant enough to be important at the species level. For example, the species of *Helvella* vary from glabrous through pubescent to villose. *H. latispora* and *H. albella* are finely pubescent initially, but may be nearly glabrous by maturity. Some variation occurs between the excipulum and stipe. *Helvella atra*, for example, has a glabrous excipulum, but a finely pubescent stipe. Some species (e.g., *H. corium, H. verruculosa*) or individual specimens are often most densely pubescent at the margin, and have progressively finer vestiture towards the base and on the stipe. Variation is frequently seen in arctic and alpine species which have heavier vestiture in arctic regions than in temperate regions. Correlated with this is the presence of a white marginal region (Fig. 11a). The white margin is composed of fascicles of hyaline hyphal hairs and sometimes crystalline, probably calcium, deposits (Harmaja 1977b) (e.g., *H. corium, H. verruculosa,* and *H. aestivalis).* This feature has been used to subdivide species into several taxa (Nannfeldt 1937; Dissing 1964), but is not considered to have taxonomic value here since it likely reflects environmental rather than genetic differences. Vestiture in other genera is more uniform, and therefore of less use in defining species. *Gyromitra* species initially have a loose weft-like pubescence, but this often disappears at maturity.

Apothecium flesh is brittle in all species. *Gyromitra* species have thick flesh (2-5 mm), while *Helvella* and *Pseudorhizina* species have thin flesh (1-2 mm). Odour is usually indistinct in Helvellaceae, but is noticeable in dried ascocarps of *H. silvicola* and strong in fresh specimens of at least some species of *Hydnotrya*. Strong odour in hypogeous species is associated with dispersal by mammals.

Microscopic characters. Measurements and observations from light microscopy (LM) were from distilled water mounts. McKnight (1968) reports alteration of spore size, shape, apiculation, and surface ornamentation in *Gyromitra* subgenus *Discina* when viewed in KOH, a commonly used rehydrant. KOH mounts are useful for observation of setoid paraphyses of *Helvella crassitunicata*. Some microscopic features of the hymenium and excipulum are presented in Figs.18-28.

The apothecium is divided into hymenium, subhymenium, medullary excipulum, and ectal excipulum (terminology following Korf 1973a)(Fig. 20), but a distinct ectal excipulum layer is not found in some taxa, and the subhymenium may be indistinct (Fig. 19). Excipulum anatomy has been used to delimit genera and species (Dissing 1966b; Harmaja 1977b, 1979a; Weber 1972; Eckblad 1968). We agree that this character is of great value in the recognition of tribes and genera within the family, but the thickness and pigmentation of tissue layers are highly variable and of limited use to delimit species (in agreement with Häffner 1987). The ectal excipulum is morphologically distinct from the medullary tissue in *Helvella* (Fig. 20), *Underwoodia*, and *Hydnotrya*. The medullary layer is *textura intricata* while the ectal excipulum is *textura angularis* or *textura prismatica* (terminology following Korf 1973a). The pubescence on the excipular surface of *Helvella* is composed of chains of cells and/or fascicled hyphal chains extending from the ectal excipulum (Fig. 18). In *Gyromitra*, *Pseudorhizina*, and *Rhizina*, the excipulum is *textura intricata* throughout, and is not divided into distinct medullary and ectal layers (Fig. 19) at maturity. The pubescence in some species of these genera is made up of undifferentiated protruding hyphae or an evanescent ectal excipulum present on immature apothecia.

Asci are hyaline, octosporous and cylindrical (Fig. 27), and tapered below the uniseriate ascospores (Figs. 23, 24). Some species of *Hydnotrya* (e.g., *H. tulasnei*) have clavate asci, especially when immature, with irregularly biseriate or clustered ascospores. Asci range from 10 μm diam. in *Pseudorhizina* to 30 μm diam. in *Hydnotrya*, and are usually 100-400 μm long. The indehiscent asci in *Hydnotrya* represent a derived feature associated with hypogeous fruiting. Hawker (1968b) and Zhang (1991) have also observed operculi (Fig. 28) in *Hydnotrya cerebriformis*.

Much attention has been given to the structure of the ascal base and mode of ascus development in *Helvella* (Weber 1972; Harmaja 1977a). Pleurorhynchous asci have a forked ascus base (Fig. 23) originating from a crozier during ascus development, while aporhynchous asci have a simple base (Fig. 24) from lack of a crozier during ascus development (Weber 1972). This feature is best observed in KOH squash mounts of immature asci and the feature is noted where taxonomically important. Differences have been used to define sections within the genus (Weber 1972; Harmaja 1977a); however, this feature may be variable. For example, *H. aestivalis* is described as having aporhynchous asci (Dissing 1983), but our observations clearly show croziers (Fig. 23). If the species with aporhynchous asci (*H. leucomelaena, H. crassitunicata*, and *H. oblongispora*) are more closely related to each other than to other species in our subgenus *Leucomelaenae*, this feature would support the recognition of the section *Leucomelaenae sensu stricto* within our subgenus.

Paraphyses are prominent in all taxa (Figs. 21, 27). Paraphyses are thin-walled, approximately the same length as asci, and range from 3-11 μm diam. at the apex. The broadest paraphyses are seen in species of *Gyromitra*, while *Hydnotrya* species tend to have slender paraphyses. Clavate paraphyses are typical (Fig. 27), and are gradually to abruptly enlarged at the apex. Paraphyses may be hyaline or strongly pigmented. In *Gyromitra*, the apical cells contain coarse pigmented granules, while in *Helvella* the contents are finely granular to nearly homogeneous. Some species (e.g., *Rhizina undulata*) have an extracellular pigmented matrix around the apex of the paraphyses. *Helvella crassitunicata* has thick-walled paraphyses similar to the setae of *Rhizina* *undulata* (terminology following Fitzpatrick 1917). Setae are aseptate with brown wall pigmentation (Fig. 22), and arise in excipular tissue below the hymenium.

Ascospore size varies from approximately 10 to 50 µm in length and spore shape varies from globose, subglobose, broadly ellipsoidal, ellipsoidal, subfusoidal, to fusoidal. *Pseudorhizina sphaerospora* is the only epigeous species with globose ascospores, and these are the smallest (8.5-10 µm diam.) in the family. Most species of *Helvella* have broadly ellipsoidal spores, but one subgenus (*Macropodes*) has subfusoidal spores. *Gyromitra* species have ellipsoidal to fusoidal spores up to 40 µm long, and spore shape and size are diagnostic for subgenera of the genus. The large, fusoidal ascospores of *Rhizina* are similar to species in the subgenus *Discina* of *Gyromitra*. Ascospores of *Hydnotrya* species are the largest in the family at 25-55 µm diam., and are globose to broadly ellipsoidal.

Spore size is quite variable within species and individual ascocarps. Spore length may vary over a range of 2-10 µm within species or collections. Kempton and Wells (1973) reported that spore size varied in individual ascocarps of *Gyromitra esculenta* over a six week period, with early spores slightly smaller than later spores and that different regions of the hymenium on individual ascocarps matured at different times. Donadini (1986a) observed that submature but viable spores of some *Gyromitra* species are often ejected from the asci. Harmaja (1977b) reported that in *Helvella* submature spores within the asci were often slightly larger than fully mature ejected ascospores. Dissing and Nannfeldt (1966) and Harmaja (1977b) reported that abnormally large spores (macrospores) sometimes occur and this has been confirmed in this study. Spore volume may be somewhat more constant than spore dimensions (i.e., the longest spores are often the narrowest and vice versa). All ascospores are hyaline and thin-walled with the exception of *Hydnotrya* which has a thickened epispore. Spore ornamentation is an important character but is difficult to assess with the light microscope (see SEM notes below). By LM, spores of *Helvella* are smooth; the verruculose spores of subgenus *Macropodes* excepted. Species of *Gyromitra* vary from smooth to distinctly warted, roughened, or reticulate. The large nodulose warts visible on ascospores of *Underwoodia* are diagnostic at the generic level. *Hydnotrya* spores appear greatly thickened with a nearly smooth, nodulose, or echinate surface. The presence or absence of spore apiculi is diagnostic at the specific, subgeneric, and/or generic levels, but may be variable in some taxa. Spores of many species of *Gyromitra* and *Rhizina* appear apiculate in water mounts, while all species of *Helvella*, *Underwoodia*, and *Pseudorhizina* lack apiculi. One species of *Hydnotrya*, *H. cubispora*, has ascospores with a thickened apical region which may appear apiculate.

Ascospores of Helvellaceae contain large lipid reserves (Gibson and Kimbrough 1988a, b; Kimbrough *et al.* 1990), and variation in the number and distribution of guttules is useful. Species of *Helvella*, for example, have a large central subglobose guttule, while species of *Gyromitra* in subgenera *Gyromitra* and *Melaleucoides* have two smaller globose guttules. Most Helvellaceae lack de Bary bubbles (Dodge 1957), but they were observed in a small proportion of the spores mounted in KOH, Melzer's Reagent or Cotton Blue in *Gyromitra melaleucoides, G. infula, Pseudorhizina sphaerospora* (Fig. 26b), *P. californica, Rhizina undulata* (Fig. 26a), *Hydnotrya cerebriformis,* and *H. variiformis*. Harmaja (1973, 1974c) suggests that de Bary bubbles may be important at the generic level, but variability limits their use. For example Harmaja (1974c) reports rare de Bary bubbles in *Gyromitra ambigua*, but lacking in *Rhizina undulata*. Ascospores possess a cyanophilic (deeply stained in Cotton Blue) perispore at maturity with the exception of *Pseudorhizina*. This character is important at the generic level (Harmaja 1974b) and is useful in other genera of Pezizales (Harmaja 1974d; Egger pers. comm.). The ascospores of Helvellaceae contain four nuclei at maturity (Harmaja 1976b; Pfister 1980; Berthet 1982; Donadini 1986b; Kimbrough *et al.* 1990, 1996; Zhang and Minter 1989a,b). We have confirmed this in *Pseudorhizina sphaerospora*, *Helvella crispa*, and *Hydnotrya cerebriformis*.

SEM observations on spores of Helvellaceae, including the genera *Helvella, Underwoodia, Gyromitra, Pseudorhizina, Rhizina, Hydnotrya,* and *Gymnohydnotrya* indicated spore wall features are useful (McKnight and Batra 1974; McKnight 1973; Dissing 1972; Harmaja 1976d; Donadini 1986a; Trappe 1976; Zhang and Minter 1989a, b). We have examined with the SEM spores of all species described here. The results have taxonomic value at the generic, subgeneric, and specific levels in various taxa of the family but must be interpreted cautiously. Variation among species is often no greater than that among individuals of the same species and often cannot be used as a primary means of species identification. Intraspecific variation in spore ornamentation between different collections and/or different spores from the same ascocarp is attributed primarily to ascospore maturity (see notes below). For this reason, it is necessary to standardize the parameters for selecting spores for measurement and description. In our work, we considered ascospores mature if they had been ejected (in epigeous forms) and were adhering to the excipulum. Hypogeous taxa were studied by crushing apothecial tissue on a stub; spores were considered mature if they had well developed ornamentation. Figs. 29-64 show the diversity of ascospore ornamentation and apiculation with the SEM.

Only *Gyromitra* has been studied intensively by SEM. McKnight and Batra (1974) divided species into three groups based on ascospore morphology. They recognized that closely related species had similar morphology, but their spore groups do not correspond to the subgenera proposed here. In a more comprehensive study, Donadini (1986a) discussed the variation in spore ornamentation of the genus. He showed that submature spores typically have a finer, less developed surface ornamentation and that these submature spores are often ejected from the asci before development is complete. This is significant in the interpretation of the observations by McKnight and Batra (1974) and Harmaja (1976d). Harmaja (1976d) describes *G. montana* as having less ornamentation than *G. gigas* and used this character to separate the taxa. Our observations show a similar degree of variation in ornamentation in collections referable to both taxa *sensu* Harmaja (Figs. 35-38). A similar situation occurred in the work of McKnight and Batra (1974) who separated weakly and strongly ornamented spores of *G. gigas* (as *G. gigas* and *G. fastigiata* respectively) and *G. leucoxantha* (as *Discina larryi* and *D. leucoxantha* respectively). Examination of the holotype of *G. larryi* indicates it is an immature specimen of *G. leucoxantha*. Recognition of the variation in spore morphology (and correlation with other features) permits the division of *Gyromitra sensu lato* into four subgenera. Subgenus *Gyromitra* has spores with finely rugose perispore ornamentation, only slightly inflated apiculi if present (Figs. 29, 30), and corresponds to McKnight and Batra's (1974) Group 1 (although they also include a species of *Pseudorhizina*). Subgenus *Discina* has finely to distinctly rugose submature spores (Figs. 31, 36, 37), often with a distinct, irregular reticulum in mature spores (Figs. 33, 34, 38). Inflated spore apiculi are present and may be well developed (Figs. 31, 33-35) or reduced in some species or individual spores (Figs. 32, 37, 38). This subgenus includes species in Group 2 and some species from Group 3 of McKnight and Batra (1974). Subgenus *Caroliniana* displays regular, widely spaced reticula and prominent spicules at the apices of ascospores (Fig. 39). Submature spores may be weakly ornamented as in subgenus *Discina*, but evidence of the reticulum and spicules is usually present. Species in this subgenus are referred to Group 3 of McKnight and Batra (1974). The fundamental difference between species with an irregular, closely spaced reticulum and solitary inflated apiculi and those with a regular, widely spaced reticulum and multiple apical spicules was not recognized when McKnight and Batra included all species with a reticulum in Group 3. The apiculi of species in the subgenus *Discina* are inflated regions of the perispore which often have some rugosity extending onto the apiculus surface, while the apical spicules of the subgenus *Caroliniana* are projections continuous with the reticulum. Subgenus *Melaleucoides* has a distinctive pattern of ornamentation separating it from all others in the genus; the rough ornamentation visible with the LM is of isolated warts (Fig. 40).

Pseudorhizina species have finely rugose spores (Fig. 41). This ornamentation is most similar to species in *Helvella* and *Gyromitra* subgenus *Gyromitra*, although even less pronounced, and lead McKnight and Batra (1974) to include species of this genus in their Group 1.

The finely rugose ascospores of *Rhizina undulata* (Fig. 43) are similar to *Gyromitra ambigua* and other species of *Gyromitra* (compare Figs. 29, 30, 37, 43). The apicular striations (Fig. 44) are identical to *G. perlata* (Fig. 33) in subgenus *Discina*.

Ascospores of *Helvella* species appear smooth by LM and with the SEM at lower magnifications. At 1500X or greater, the finely rugose perispore is distinctive (Figs. 46, 49, and 50). The similarity in ornamentation of *H. silvicola* (Fig. 51) with others in the genus supports its inclusion in *Helvella* and rejection of the name *Wynnella*. The only *Helvella* species with a different ornamentation is *H. macropus*. The verruculose ornamentation by SEM consists of numerous short spines (Figs. 53-56). This feature, as well as ascospore shape and guttulation, supports Häffner's (1987) separation of the section *Macropodes* (*sensu stricto*), which is recognized as a distinct subgenus. Some spores may appear finely rugose (Fig. 57)(or smooth by LM), similar to other *Helvella* species, and probably represent submature spores.

Underwoodia has been synonymized with *Helvella* by some authors (Eckblad 1968; Harmaja 1974a), but unique ascospore ornamentation supports its retention in a separate genus. The spore is covered with irregular, broadly rounded, nodulose warts (Fig. 42). The small pits in the perispore, noted by McKnight and Batra (1974), and the irregular cracking of the spore surface (Fig. 42), are not of taxonomic value.

Species in *Hydnotrya* fall into two distinct spore groups which are given recognition at the subgenus level. Subgenus *Hydnotrya* has smooth spore walls which are extensively thickened with an adhering amorphous epispore, often with a broadly rounded or nodulose surface (Fig. 61). In subgenus *Cerebriformae*, the ascospores are echinate with distinct projections of the spore wall extending from the surface (Fig. 64). In *Hydnotrya cerebriformis*, the spore surface may be partially or completely covered with an adhering matrix similar to that observed by Hawker (1968a) for *Elaphomyces*. Spines are often aggregated by the adhering matrix, giving a warted or cracked appearance (Fig. 63). Species of *Gymnohydnotrya* also have echinate ascospores (Zhang and Minter 1989b).

Ecology and biogeography. The Helvellaceae demonstrate a wide variety of trophic abilities. *Gyromitra* and *Pseudorhizina* are common on wood and other plant debris and are assumed to be saprophytes (e.g., Benedix 1969), although *G. infula* might be a very weak pathogen (Egger and Paden 1986b). Some species of *Gyromitra* are easily cultured (Abbott unpublished data; Roponen and Kreula 1978; Raudaskoski *et al.* 1976; Egger and Paden 1986b; Groves and Hoare 1953) supporting the assumption that they are saprophytic. *Rhizina* is pathogenic on conifer seedlings (Ginns 1968, 1974a; Satô *et al.* 1974; Morgan and Driver 1973; Morgan *et al.* 1974; Thies *et al.* 1977; Egger and Paden 1986a; Callan 1990) and can be cultured also (Sato *et al.* 1974; Ginns 1974b; Egger and Paden 1986a, b).

The trophic strategies of *Helvella* are unknown, although *H. crispa* and *H. corium*, as well as *Gyromitra esculenta* and *G. infula*, are listed as mycorrhizal in Maia *et al.* (1996) and Trappe (1971) based on literature reports. Smits'ka (1981) also lists *Helvella* and *Gyromitra* as mycorrhizal. Mycorrhizal capabilities of *H. lacunosa* have been described by Martinez-Amores *et al.* (1991). It has not been possible to culture species of *Helvella* even though numerous attempts have been made (Abbott unpublished data; Weber pers. comm.), although one putative culture of *H. lacunosa* (UAMH 6474) was obtained from Europe. In general, the nutritional fastidiousness (*Helvella* and *Hydnotrya*) and the lack of conidia (*Gyromitra*) in the Helvellaceae may be evidence supporting mycorrhizal tendencies (Hutchison 1989). Hypogeous species are probably ectomycorrhizal with coniferous and deciduous trees (Maia *et al.* 1996), but experimental evidence is lacking (Trappe 1971). The recent collections of *Hydnotrya cubispora*, an endemic North American species, from non-native European plantations of *Picea*, also indicates a mycorrhizal relationship with conifers (Pegler *et al.* 1993).

Species exhibit some seasonality with respect to fruiting with some being vernal (e.g., *Gyromitra esculenta, G. perlata, Helvella leucomelaena*) others autumnal (e.g., *Gyromitra infula, Helvella lacunosa*) and some, such as *Helvella lacunosa, H. maculata, H. compressa,* and *Gyromitra infula,* may fruit throughout the winter in coastal regions. Some vernal species (e.g., *Gyromitra gigas*, *G. olympiana*) are often associated with melting snowbanks. Fruiting body development may occur slowly (especially in *Gyromitra*)(Kempton and Wells 1973; Jalkanen and Jalkanen 1981, 1984; Moravec 1966) and ascospores may mature at different times within different regions of individual ascocarps (Kempton and Wells 1973; Donadini 1986a). Both tactics maximize reproductive potential. Hypogeous species are dispersed primarily by rodents in addition to other mammals and invertebrates which feed on the fruiting bodies (Fogel 1976).

With respect to biogeography, some species are restricted to arctic and alpine tundra regions (e.g., *Helvella aestivalis, H. verruculosa*), while others are circumboreal, occurring in similar habitats in Europe, Asia, and North America (e.g., *Helvella crispa, Gyromitra esculenta*). Some are widely distributed in the northern hemisphere in a range of habitats including deciduous and coniferous woods or tundra, and on soil, humus, or rotted wood (e.g., *Helvella lacunosa, Gyromitra gigas*). Others prefer specific substrata such as wood (*Pseudorhizina sphaerospora*), leaf litter/humus (*Helvella macropus*), or mineral soil (*H. leucomelaena*). Many species of *Helvella* tend to fruit on calcareous soil (Dissing 1966b; Petersen 1985; Abbott pers. obs.).

Geographic distribution can help delimit species. Some species are endemic to Europe or North America (e.g., *Gyromitra parma* and *Gyromitra melaleucoides* respectively), while others are widely distributed in northern temperate regions (e.g., *Helvella crispa, Hydnotrya tulasnei*). A few have an even broader geographic range in the northern and southern hemispheres (e.g., *Helvella leucomelaena, H. chinensis*). Few have been described exclusively from montane tropical regions (e.g., *Helvella papuensis* Dissing 1979).

Species endemic to the study area include *Helvella robusta* and *H. crassitunicata*, but further collecting may expand this range. Several other species are restricted to western North America and occur south of the study area (*Gyromitra melaleucoides, Pseudorhizina californica, Helvella compressa,* and *H. variiformis*). The reported arcto-tertiary disjunct distribution of *Helvella maculata* in northwestern North America and China (Cao *et al*. 1990) is unique in the family.

Many closely related species are sympatric (e.g., *Helvella acetabulum* and *H. costifera*) throughout their range, while others are partially sympatric, especially if one is restricted in distribution (e.g., *Helvella crispa* and *H. maculata*).

Geographic distribution is useful in identification when two closely related species are allopatric. For example, *P. sphaerospora* occurs in Europe, Asia and eastern North America, while *P. californica* is only in western North America. The ranges of the two species approach each other on either side of the continental divide (Map 8). The species of *Underwoodia* are unusually disjunct with each of the three species restricted to North America, South America, and Australia respectively.

Morphologically distinct forms may occur in different environmental regions and in these cases it can be difficult to evaluate taxonomic identity (i.e., whether the morphological features are altered by different conditions, or if distinct species are restricted to different habitats)(e.g., *Helvella palustris* and *H. lacunosa,* Häffner 1991). Taxonomic problems also arise from morphological differences seen between geographic locations. For example, variations in *G. gigas* (*sensu lato*) in Europe, eastern North America, and western North America suggest possible taxonomic divergence, yet the degree of overlap in morphology and distribution is great.

Phylogenetic Relationships of the Helvellaceae

Relationships within the Pezizales. The Helvellaceae are placed in the Pezizales. Until recently this order was restricted to operculate taxa (e.g., Eckblad 1968; Korf 1972) but a broader concept now includes taxa with indehiscent asci that are clearly recent derivations from operculate forms (Trappe 1979; Eriksson and Hawksworth 1993). These include hypogeous members which were traditionally treated together (Harkness 1899; Massee 1909) and often classified in the Tuberales (Gilkey 1916, 1939; Hawker 1954, 1955, 1974; Korf 1973a). The Helvellaceae are among the few families in the order (also Pezizaceae and Otidiaceae) that include both operculate epigeous and indehiscent hypogeous taxa. Morphological similarities between epigeous and hypogeous taxa indicate that the family is monophyletic, despite obvious differences in ascus structure. The unified concept of the family is based on the presumed monophyletic origin of all taxa with tetranucleate ascospores.

The relationship of Helvellaceae to other Pezizales is unclear. The family is considered to be highly evolved because of the complex apothecia and tetranucleate spores (Nannfeldt 1937; Eckblad 1968; Dissing 1966b). Taxa considered primitive exhibit simple cupulate apothecia and uninucleate ascospores (Eckblad 1968). Korf (1972, 1973a) places the Helvellaceae in the suborder Pezizineae along with the families Morchellaceae, Pezizaceae, Pyronemataceae (*sensu lato*), and Ascobolaceae. This suborder is distinct from the Sarcoscyphineae (Sarcoscyphaceae and Sarcosomataceae) with suboperculate asci. Eckblad (1968) and Brummelen (1978) do not consider the two groups distinct subordinal taxa. The distinction is also not supported by Harmaja (1974c) who found that Sarcoscyphineae have perisporous ascospores, a characteristic also found in many Pezizaceae, Helvellaceae, and Pyronemataceae (*sensu lato*).

The 'helvelloid' taxa have been placed close to, and often in the same family with, the 'morchelloid' taxa (e.g., Fries 1823; Seaver 1928; Groves and Hoare 1953; Imai 1932, 1954). These groups are distinct because the Morchellaceae possesses multinucleate rather than tetranucleate ascospores, and ascospores with external rather than internal oil guttules (Eckblad 1968; Korf 1972; Eriksson and Hawksworth 1993). Smits'ka (1981) derives the Morchellaceae from the Helvellaceae. The similar excipulum structure in the Morchellaceae and in *Helvella* (Eckblad 1968) may indicate relationship. Samuelson (1978) reports that the ascal apices of *Helvella* and *Morchella* are also similar. Nannfeldt (1937) and Eckblad (1968) suggest that the Morchellaceae and Helvellaceae are monophyletic groups derived independently from less advanced members of the Pezizales, and that the complex ascocarps are the result of parallel or convergent evolution. However, given the diversity of species and genera in the Pezizales, it is likely that the Helvellaceae and Morchellaceae are more closely related to each other than to other families, such as Pezizaceae or Sarcosomataceae.

Several genera have been suggested as possible ancestors of the Helvellaceae. Nannfeldt (1937), Eckblad (1968), and Smits'ka (1981) suggest a close affinity between *Helvella* and *Pustularia* (=*Tarzetta*) based on similarities of excipulum, ascospores, and paraphyses. Maas Geesteranus (1967) even included *Pustularia* in the Helvellaceae. Eckblad (1968) further suggested that the Helvellaceae (*sensu* Eckblad) is derived from the Otideaceae (*sensu* Eckblad containing *Otidea*, *Pustulina* (=*Tarzetta*), *Sowerbyella*, *Geopyxis*, and *Ascosparassis*), and he separates the Otideaceae from the polyphyletic Pyronemataceae (supported by Kimbrough 1989). Benedix (1962) also suggests an affinity with *Geopyxis*. Dissing (1966b) considers these taxa distant from the Helvellaceae and was not able to suggest an ancestor. Recent transmission electron microscope (TEM) studies by Kimbrough and Gibson (1990) have shown that the structure of the ascus pore plugs and ascospore secondary wall in *Geopyxis* are most similar to the Helvellaceae. The uninucleate ascospores which contain only small oil reserves would exclude *Tarzetta* (=*Pustularia*, =*Pustulina*) and *Geopyxis* from the Helvellaceae.

Eckblad (1968) considered the Helvellaceae (*Helvella* and others) and Rhizinaceae (*Gyromitra* and others), as independent derivations from pezizoid ancestors. Smits'ka and Slavnaya (1978) and Harmaja (1969a, 1974b) also accepted the Helvellaceae and Rhizinaceae although Harmaja (1976b) later included taxa of the Rhizinaceae in the Helvellaceae. Harmaja (1974b) also subdivided the Helvellaceae *sensu lato* by erecting the family Pseudorhizinaceae to accommodate *Pseudorhizina*, but this has received little support (Eriksson and Hawksworth 1993). Our observation of tetranucleate ascospores in *P. sphaerospora* supports the retention of *Pseudorhizina* in the Helvellaceae.

Smits'ka (1981) outlined different phylogenetic relationships among the genera: cupulate species were retained in the Pezizaceae (*sensu lato*) as the genera *Discina, Acetabula,* and *Macropodia*. The monotypic family Rhizinaceae (*Rhizina*) was derived from *Discina*. The Helvellaceae (*Helvella*) was derived from both *Macropodia* and *Acetabula* with *Helvella* giving rise to *Gyromitra* and *Helvellella* (=*Pseudorhizina*). Although this scheme recognizes the relationship between *Discina* (=*Gyromitra*) and *Rhizina,* it fails to note the even closer association of *Discina* and *Gyromitra* which are relegated to different families. The views of Eckblad (1968), Harmaja (1974b), and Smits'ka (1981) are untenable. Rather, the more unified concept of the family, as put forth by Dissing (1966b, 1972), Rifai (1968), Kimbrough (1970, 1991), Korf (1973a), Harmaja (1976b), Trappe (1979), and Eriksson and Hawksworth (1993), is supported here.

Relationships among genera. The subfamilies, genera and subgenera proposed or accepted in this study are listed in Table 1.

The five epigeous genera of Helvellaceae accepted here are divided into two tribes, Helvelleae and Gyromitreae, considered monophyletic and sharing a common ancestor. The Helvelleae includes *Helvella* and *Underwoodia*, while the Gyromitreae includes *Gyromitra*, *Pseudorhizina*, and *Rhizina*. These tribes are distinct based primarily on the structure of the excipulum and correspond to the families Helvellaceae and Rhizinaceae of Eckblad (1968). The Gyromitreae is emended to include members of the Discineae of Dissing (1966b) and Korf (1972, 1973a).

The hypogeous indehiscent genera assigned to the Helvellaceae are *Hydnotrya, Gymnohydnotrya*, *Choiromyces*, *Balsamia,* and *Barssia*. All have tetranucleate spores (Berthet 1982; Donadini 1986b; Zhang and Minter 1989a, b; Zhang 1991; Kimbrough *et al.* 1996). The subfamilial placement of these taxa is unclear. While it may seem justifiable to erect a tribe to accommodate the indehiscent, hypogeous taxa, it is possible that the hypogeous ascocarp has evolved in both tribes. Further study of these genera is needed to determine a phylogenetic placement; for now they should be considered as genera *incertae sedis* at the tribe level. Morphological similarity between *Helvella* and *Hydnotrya* has been noted by Korf (1973b) and Donadini (1983). Because species of Helvellaceae tend to become folded or convoluted, they may have easily adapted to a hypogeous existence, and the number of hypogeous genera included in Helvellaceae may continue to increase as relationships are recognized.

Within the Helvelleae, *Helvella* is considered closest to the basal taxon from which extant genera are derived. Both *Underwoodia* and *Hydnotrya* have been assigned to *Helvella* at one time or another (Eckblad 1968; Harmaja 1974a; Donadini 1983; Eriksson and Hawksworth 1993).

Eckblad (1968) and Harmaja (1974a) placed *Underwoodia* in *Helvella* but this is an untenable placement. *Underwoodia* is distinct because it has no free excipular surface; the excipulum is completely fused and continuous with the stipe tissue. The nodulose ascospores were also ignored as a character of value at the genus level, but the striking difference in morphology clearly supports taxonomic separation. The uniformity in spore morphology of all species of *Helvella* examined in this study (including those of subgenus *Macropodes*, see discussion in following section) is clearly diagnostic at the generic level and supports keeping *Underwoodia* separate from *Helvella*, although some relationship to *Helvella* is indicated by excipulum anatomy and stipe morphology.

Hydnotrya was united with *Helvella* by Donadini (1983) on the basis of similarities of excipulum structure and the uniguttulate ascospores with cyanophilic ornamentation. Excipular structure is similar in all taxa of the Helvellaceae, and species typically lacking an ectal excipulum at maturity may have an evanescent ectal layer when immature (Harmaja 1976b; McKnight 1969, 1971; Abbott unpublished data). The structure of the excipulum in *Hydnotrya michaelis* as shown in Berthet (1982) and Kers (1989) is distinct from *Helvella* as depicted in Eckblad (1968), Dissing (1966b), and Dissing and Sivertsen (1980). Considering that a single guttule in a globose or broadly ellipsoidal spore (two equal sized guttules in a narrowly ellipsoidal spore and three, with largest central guttule, in a fusoidal spore) is a physically efficient way of storing lipids (Harmaja 1973), guttule number should not be relied upon as an indicator of phylogenetic relatedness. Some members of the Gyromitreae (e.g., *Pseudorhizina sphaerospora, Gyromitra gigas*) may also have uniguttulate spores. Cyanophilic perispore-periplasm structure of mature ascospores was demonstrated by Harmaja (1974c) for *Helvella, Gyromitra,* and *Rhizina,* and is reported here for *Hydnotrya*. This feature, although absent in *Pseudorhizina*, is common in the Helvellaceae and does not necessarily imply relatedness between *Hydnotrya* and *Helvella*. A more convincing link between these two taxa is found in the description of *Helvella astieri* by Korf (1973b). Although we have not examined the type or other specimens, the description and illustrations show similarities to both *Helvella* and *Hydnotrya*. The decision to place this species in *Helvella* was based on the functional operculum, although the gross morphology of the ascocarp is more similar to *Hydnotrya*. In our opinion, the presence versus absence of a functional operculum is taxonomically significant at the generic level, which corresponds to the current recognition of genera by Eriksson and Hawksworth (1993) and Egger (pers. comm.). The discovery of *H. astieri* is also of great importance in assessing the direction of evolution in Helvellaceae. Because an enclosed 'sparassoid' ascocarp has no need for a functional operculum, it can be concluded that the dehiscence mechanism is retained from its ancestry. It is thus apparent that the indehiscent asci of hypogeous 'sparassoid' species represents a loss and that those species are more derived than those with functional operculate asci. The presence of an operculum in *Hydnotrya cerebriformis* (Fig. 28), although it is apparently not functional, also supports the derivation of hypogeous taxa from epigeous ones.

Within the Gyromitreae, the relationship of *Rhizina* to members of *Gyromitra* (e.g., *G. ambigua* and *G. perlata*), is suggested by similarities in ascospore size, shape, apiculation, and ornamentation. *Rhizina* is retained as a distinct, taxonomically isolated genus on the basis of the indeterminate growth in the margin, the presence of rhizoids continuous with the excipular surface, the presence of setae in the hymenium, and its pathogenic habit. These are specialized evolutionary traits and *Rhizina* is therefore a highly derived genus.

The phylogenetic relationship between *Gyromitra* and *Pseudorhizina* is less clear. The two genera were often placed in the same genus (e.g., McKnight and Batra 1974; Korf 1973a), but the differences in perispore staining and spore guttulation discussed by Harmaja (1974b) support the retention of *Pseudorhizina*. In *Pseudorhizina*, the apothecium flesh is thinner than in *Gyromitra*, and the margin is typically free from the prominently ribbed stipe. The structure of the excipulum is distincitive but similar to other genera of the Gyromitreae.

Subgeneric taxa. The broad generic concepts in the Helvellaceae contain subsets of closely related species. These subsets have been given the rank of section in *Helvella* (e.g., Dissing 1966b; Weber 1972; Häffner 1987) and subgenus in *Gyromitra* (e.g., Harmaja 1973; Kimbrough *et al.* 1990). In this work, the primary subdivisions of genera are considered subgenera (see Table 1). Subgenera are treated as a higher rank than sections for nomenclatural purposes (ICBN Article 4.2, Greuter *et al.* 1994). Subgenus names previously erected are retained, although some are emended. Some previously published section names are raised to the rank of subgenus (ICBN Recommendation 22A.2, Greuter *et al.* 1994), but may include several sections described by other authors (e.g., Dissing 1966b; Weber 1972; Häffner 1987). These smaller groups could still be recognized as sections within the newly proposed subgenera, although no division of subgenera is considered here. Subgenera based on species not designated as types for any previously described subgeneric division are newly described. To avoid confusion, new subgeneric names are proposed rather than using earlier generic names at the subgeneric level (unless previously established; e.g., subgen. *Discina*). These genera rarely corresponded exactly with the subgenera as outlined here, or the concept of the genus included members from more than one of the subgenera recognized in this work. The outline presented divides the genera into recognizable units of taxonomic affinity (Table 1).

The genus *Gyromitra* is divided into four subgenera on the basis of ascospore and ascocarp morphology. Subgenus *Melaleucoides* shares relatively small spore size and biguttulate ascospores with subgenus *Gyromitra*. Pfister (1980) confirmed the tetranucleate condition of *G. melaleucoides* ascospores and supports a broad concept of the genus *Gyromitra* to accommodate it. Pfister also comments that it could not be placed easily in either *Gyromitra* or *Discina sensu stricto*, recognizing the taxonomic isolation of this species. The subgenus *Discina* may also provide a link with subgenus *Melaleucoides* through *G. melaleuca*, but the placement of this species is uncertain. *G. melaleuca* is tentatively placed in the subgenus *Melaleucoides*, although it is somewhat aberrant. The spores are smaller than typical in members of the subgenus *Discina*, and the apiculi appear absent (although also inconspicuous in other species of the subgenus *Discina*, e.g., *G. olympiana*). Our SEM observations of the submature ascospores of *G. melaleuca,* along with those of Donadini (1986a), indicate that the spores appear intermediate between the rugose surface typical for subgenus *Discina* and the nodulose warted ornamentation typical for *G. melaleucoides*, the only other species in the subgenus *Melaleucoides*. The distribution of guttules within the ascospore is also intermediate. As illustrated in Benedix (1969), the spores are ellipsoidal, but some appear subfusoidal. The spores are most frequently biguttulate (with a small proportion of triguttulate spores), but the guttules are of unequal size. This pattern is also seen in a small proportion of spores in other species of the subgenus *Discina*, including *G. gigas*. Further investigation of *G. melaleuca* may reveal a closer affinity with the subgenus *Discina*. Species in subgenus *Caroliniana* have been closely allied with members of the subgenus *Discina* and were often grouped with them in the genus *Discina* (e.g., Eckblad 1968). The subgenus *Caroliniana* contains subsessile to distinctly stipitate species sharing common ascospore morphology (Fig. 39) and is more closely related to subgenus *Discina* than to other subgenera of the genus.

Rhizina is monotypic but is likely derived from a *Gyromitra*-like ancestor. The genus *Pseudorhizina* contains only a type subgenus with two closely related species (see also discussion under intergeneric relationships and notes under species).

Helvella is divided into six subgenera, which are emended to include species treated in various sections *sensu* Dissing (1966b) or Häffner (1987). Subgenus *Helvella* represents a high level of development due to the complex apothecium and stipe morphology (Figs. 6-8). The ancestral form of species in the subgenus *Helvella* may have been similar to *H. solitaria* placed in a basal taxonomic position of the subgenus *Leucomelaenae. H. solitaria* is a variable taxon; large representatives of this species have a pronounced stipe with anastomosed branches and internal chambers reminiscent of *H. maculata* in subgenus *Helvella*. Species in the subgenus *Leucomelaenae* with complex ribbing on stipe and excipular surface (e.g., *H. acetabulum, H. costifera*) (Fig. 3e) are derived from simpler forms similar to *H. leucomelaena* (Fig. 3a) or *H. solitaria* (Fig. 3b). The subgenus *Silvicolae* is likely derived from an ancestor similar to species in the subgenus *Leucomelaenae*. The indistinct, sparingly ribbed stipe of *H. silvicola* (Fig. 4a,c) is similar in construction to *H. leucomelaena* (Fig. 3a) and *H. aestivalis*. The strongly one-sided apothecium and ascocarp coloration typical of *H. silvicola* are also seen to a much lesser extent in the aforementioned taxa. The subgenus *Leucomelaenae* is also allied with the subgenus *Cupuliformae*. Small slender forms of *H. solitaria* are morphologically similar to *H. cupuliformis* and *H. corium* placed in the subgenus *Cupuliformae*. Subgenus *Macropodes* is most closely related to *Cupuliformae*. Subgenus *Elasticae* is clearly derived from species in the subgenus *Cupuliformae*. Similarities between members placed in a basal taxonomic position of the subgenus

Elasticae (e.g., *H. ephippium, H. pezizoides*) are only slightly more complex than some species of subgenus *Cupuliformae* (e.g., *H. chinensis*). The subgenus *Elasticae* represents an advanced lineage. Species such as *H. elastica* and *H. leucopus* are among the most highly derived species of subgenus *Elasticae* on the basis of elaborate apothecia reflexed to stipe, glabrous excipular surface, and hollow stipe.

The genus *Underwoodia* contains only a type subgenus of at least three closely related species. Although the species of *Underwoodia* have been said to differ little in ascocarp morphology from species such as *H. lactea* in *Helvella* subgenus *Helvella* (Harmaja 1974a), direct phylogenetic relationship between these taxa has not been demonstrated and evidence to indicate that *Underwoodia* is derived from subgenus *Helvella* is lacking (see also notes under intergeneric relationships).

Hydnotrya is divided into two subgenera on the basis of ascospore morphology. Members of the type subgenus have subglobose to broadly ellipsoidal ascospores with smooth walls that are irregularly thickened by an amorphous epispore (Figs. 59-62). *H. cerebriformis* is placed in a subgenus of its own on the basis of the unique globose, echinate ascospores (Figs. 63, 64). Trappe (1979) suggested that this may deserve generic separation, but is retained in *Hydnotrya* based on gross morphological similarity, an admittedly unreliable character in hypogeous fungi (Zhang 1991). The tetranucleate ascospores of *H. cerebriformis* confirms the placement of this species in the Helvellaceae. Ascospore morphology is also variable in the hypogeous genera *Choiromyces* (Helvellaceae; see Trappe 1979) and *Tuber* (Tuberaceae; see Lange 1956). The SEM studies of *Gymnohydnotrya* by Zhang and Minter (1989b) show similar ascospore ornamentation to *Hydnotrya cerebriformis*.

TABLE 1: Taxa of Helvellaceae[1]

FAMILY:	Helvellaceae (44)
TRIBE:	Gyromitreae (11)
GENUS:	*Gyromitra* (8)
SUBGENUS:	*Caroliniana* (0)
	Discina (4)
	Gyromitra (3)
	Melaleucoides (1)
GENUS:	*Pseudorhizina* (2)
GENUS:	*Rhizina* (1)
TRIBE:	Helvelleae (33)
GENUS:	*Helvella* (27)
SUBGENUS:	*Cupuliformae* (4)
	Elasticae (7)
	Helvella (4)
	Leucomelaenae (10)
	Macropodes (1)
	Silvicolae (1)
GENUS:	*Underwoodia* (1)
TRIBE:	genera *incertae sedis*
GENUS:	*Hydnotrya* (5)
SUBGENUS:	*Hydnotrya* (4)
	Cerebriformae (1)
GENUS:	*Gymnohydnotrya* (0)
	Balsamia (not examined)
	Barssia (not examined)
	Choiromyces (not examined)

[1] number of species examined from northern and northwestern North America in brackets after taxon.

Taxonomic part

Generic, subgeneric, and specific taxa are described and presented in alphabetical order within each higher taxon (i.e., species arranged alphabetically within subgenera, subgenera alphabetically within genera, genera alphabetically within tribes), with the exception of extralimital taxa which are listed alphabetically at the end of their respective subgeneric or generic section. Keys to all tribes, genera, and subgenera are included individually and should be followed sequentially. Only species found to occur within the study area are keyed. Extralimital species are included to elucidate differences between closely related or morphologically similar taxa, and notes are provided for all taxa reported from the area. Inclusion of other extralimital taxa was required to provide a more comprehensive view of the taxonomic diversity of the Helvellaceae.

Descriptions of genera and subgenera include authority and citation, synonyms, type species, and morphological features.

Species concepts are taxonomic (rather than biological or ecological) ones and are defined on the basis of multiple correlation of features. Our species are "the smallest groups that are consistently and persistently distinct, and distinguishable by ordinary means" (Cronquist 1988). Characters of importance at the species level include ascocarp size, shape, colour, excipulum vestiture, stipe construction, ascospore size, shape, and ornamentation, and features of the paraphyses and asci.

Species are presented with authority and citation, basionym and synonyms, type information, illustrations (included here), morphological description (in order of apothecium, stipe, asci, paraphyses, and ascospores) based on dried material except where noted, habitat (abundance, substratum, phenology, associated plant species in order of decreasing frequency, etc.), geographic distribution, taxonomic notes, and collections examined. Full descriptions are provided only for species from the study area, while nomenclatural information, geographic distribution, taxonomic notes, and collections examined are provided for extralimital species.

Synonyms provided are not exhaustive, and are provided to help users access names from recent North American and European references (or those in current use) and names for which type or authentic material has been examined. Type material likewise is provided to allow quick access to the status and location of type specimens, with notation if examined/selected in this study. Complete type specimen details are provided in the collections examined section.

The notes section includes a discussion of the species concept, subspecific taxa and relationships to similar taxa. Collections are listed by location, collector (including number) and date (month day year) together, and herbarium accession data. Further, they are arranged by province or state, west to east from the north to the south (i.e., read each province/state on a map from the upper left corner across, then down line by line) with those from the study region first (Canada first, then USA). National and provincial parks are indicated by N.P. and P.P., respectively; counties as Co. Other collections are listed by country in approximate order from west to east and north to south. *Exsiccatae* follow.

Helvellaceae Fries, 1823, Systema Mycologicum 2: 1. (s.n. Elvellaceae).

=Rhizinaceae Bonorden, 1851, Handbuch der allgemeinen mykologie als anleitung zum studieum derselben p. 200. (s.n. Rhizinacei).

=Balsamiaceae E. Fischer, 1897, Tuberaceen und Hemiasceen, in Rabenhorst Kryptogamen-Flora von Deutschland, Österreich und der Schweiz 5: 3-81.

=Hydnotryaceae M. Lange, 1956, Dansk Botanisk Arkiv 16: 27.

=Discinaceae Benedix, 1961, Zeitschrift für Pilzkunde 27: 100.

=Pseudorhizinaceae Harmaja, 1974, Karstenia 14: 110.

Key to tribes and genera of Helvellaceae

1. Ascocarps hypogeous; asci indehiscent; ascospores thick-walled and pigmented ....**Tribe *incertae sedis*.....*Hydnotrya***

1'. Ascocarps epigeous; asci operculate; ascospores thin-walled and hyaline..............2

 2. Apothecial excipular tissue (as seen in cross section) at maturity of *textura intricata* throughout, sometimes with an indistinct evanescent ectal layer of *textura angularis* (Fig. 19)......................**Tribe *Gyromitreae*** 3

 2'. Apothecial excipular tissue (as seen in cross section) distinctly stratified at all stages of development, with medullary excipulum of *textura intricata* and prominent ectal excipulum of *textura angularis* and/or *textura prismatica* (Fig. 20)...............................**Tribe *Helvelleae*** 5

3. Ascocarps sessile, with rhizoids extending from excipular surface; thick-walled setae present in hymenium....................................***Rhizina*** ....**(*R. undulata*)**

3'. Ascocarps stipitate or sessile, excipular surface lacking rhizoids; setae absent from hymenium...4

 4. Ascospores at maturity with cyanophilic perispore (deeply stained in Cotton Blue); flesh of fresh apothecia relatively thick (2-5 mm)...***Gyromitra***

 4'. Ascospores at maturity lacking cyanophilic perispore; flesh of fresh apothecia relatively thin (1-2mm)....................***Pseudorhizina***

5. Ascospores smooth to verruculose (with SEM spore surface uniformly finely rugose to finely verrucose); apothecium at least partially free of stipe with distinct excipular surface...***Helvella***

5'. Ascospores nodulose (with SEM spore surface smooth with large isolated rounded warts); apothecium entirely fused to stipe and lacking a distinct excipular surface...***Underwoodia*** ....**(*U. columnaris*)**

Tribe Gyromitreae Dissing, 1966, Dansk Botanisk Arkiv 25: 28. *emend. nov.*
=Tribe Discineae Dissing, 1966, Dansk Botanik Arkiv 25: 29.

Notes: This tribe is emended to include both tribe Gyromitreae and Discineae of Dissing 1966b. Three genera are recognized: *Gyromitra* (*sensu lato*), *Pseudorhizina,* and *Rhizina.*

Gyromitra Fries, 1849, Summa Vegetabilium Scandinaviae 2: 346. (*nomen conservandum* ICBN Appendix IIIA, Greuter *et al.* 1994).
=*Gyrocephalus* Persoon, 1824, in Mémoires de la Société Linnéene (Paris) 3: 77. (*nomen rejiciendum* ICBN appendix IIIA, Greuter *et al.* 1994).
=*Discina* (Fries) Fries, 1849, Summa Vegetabilium Scandinaviae 2: 348.
=*Physomitra* Boudier, 1885, Bulletin de la Societé Mycologique de France 1: 99.
=*Neogyromitra* S. Imai, 1932, The Botanical Magazine (Tokyo) 46: 174.
=*Paradiscina* Benedix, 1969, Die Kulturpflanze 17: 274.
=*Fastigiella* Benedix, 1969, Die Kulturpflanze 17: 276.

Type Species: *Gyromitra esculenta* (Persoon) Fries, 1849, Summa Vegetabilium Scandinaviae, 2: 346.

Macroscopic Features: ascocarp epigeous, sessile, subsessile, or distinctly stipitate; apothecium cupulate, discoid, convex, bilobate, or irregularly lobed, margin inrolled or reflexed; hymenium yellow brown to red brown or dark brown, nearly smooth to undulate-rugose or highly convoluted; excipular surface nearly glabrous to pubescent, smooth, leathery when dry; stipe equal, flaring and merging with apothecium, or tapered to base, white to red brown, or with purple tints, nearly glabrous to pubescent, often fluted, internally solid or with hollow chambers; flesh thick, 2-5 mm when fresh, brittle. **Microscopic Features:** asci cylindrical, tapered to base, hyaline, operculate, containing eight uniseriate ascospores; paraphyses clavate, enlarged gradually or abruptly at apex, brown, contents finely to coarsely granular; ascospores ellipsoidal to fusoidal, hyaline, smooth to distinctly rough with light microscope, with SEM (or oil immersion) finely to coarsely rugose, reticulate, or distinctly warted, non-apiculate to distinctly apiculate, with one, two, or three guttules, tetranucleate, de Bary bubbles absent or rarely present, cyanophilic perispore present at maturity; tissues in cross section more or less uniform *textura intricata* with no distinct separation of medullary and ectal excipulum at maturity, an evanescent ectal layer of *textura angularis* present initially.

Key to subgenera of *Gyromitra*

1. Ascospores biguttulate.. 2
1'. Ascospores uniguttulate or triguttulate.. 3
    2. Ascospore ornamentation finely rugose (appearing
        smooth by LM)..**subgen. *Gyromitra***
    2'. Ascospore ornamentation of isolated rounded warts...**subgen. *Melaleucoides***
        ....**(*G. melaleucoides*)**
3. Ascospore ornamentation rugose or an irregular, closely spaced reticulum;
    distinct or indistinct solitary apiculi present, apiculi formed from
    inflation of perispore at spore apices.............................. **subgen. *Discina***
3'. Ascospore ornamentation a regular, widely spaced reticulum; distinct
    multiple apiculi present, apiculi formed from extension of reticulum
    into spine-like projections at spore apices .... **subgen. *Caroliniana***

Gyromitra Subgenus *Caroliniana* S.P. Abbott, *subgen. nov.*

Apothecia subsessilia vel stipitata, convexa vel irregulariter cupulata, hymenium rugosum vel convolutum; ascosporae ellipsoideae vel subfusoideae, uniguttulatae vel triguttulatae, reticulatae, utroque apice spinuloso.

Type Species: *Gyromitra caroliniana* (Bosc : Fries) Fries, 1871, Öfvers. af Kongl. Vet.-Akad. Förhandl. 2: 173.

Ascocarp: subsessile to stipitate, cupulate, discoid, convex, or irregularly lobed; hymenium orange brown to red brown, rugose. **Ascospores:** ellipsoidal to subfusoidal, uniguttulate to triguttulate, appearing distinctly rough to reticulate with light microscope, with SEM ornamentation composed of coarse complete reticulum at maturity, apices with multiple spines arising from reticulum.

Notes: The subgenus is characterized by spores covered with a coarse, regular, widely spaced reticulum, and the apical regions are ornamented with multiple blunt spines continuous with the reticulum (Fig. 39). This is in contrast to the inflated solitary apiculi of subgenus *Discina*. The spore ornamentation develops slowly as in subgenus *Discina* and nearly smooth submature spores may be discharged from the asci (Abbott pers. obs.; see also Donadini 1986a). Ascospores are often uniguttulate, but the presence of one or two smaller apical guttules is not uncommon. Ascocarp morphology and coloration is also similar to species in the subgenus *Discina*, and these features suggest taxonomic affinity between subgenera *Discina* and *Caroliniana*.

Benedix (1969) recognized that the group of 'gyromitroid' fungi with regularly reticulate and apically spined spores deserved taxonomic recognition and erected the genus *Fastigiella* to accommodate *G. caroliniana*. The illustration of *F. caroliniana* represents *G. fastigiata* as recognized in this work in agreement with the concepts of Svrcek and Moravec (1972), Harmaja (1973), and Weber (1988). Harmaja (1976b) places *Fastigiella* in synonymy with *Gyromitra sensu lato*.

None of the three species recognized in this section is known from the study area.

Extralimital Species

Gyromitra caroliniana (Bosc : Fries) Fries, 1871, Öfvers. af Kongl. Vet.-Akad. Förhandl. 2 : 173.

≡*Morchella caroliniana* Bosc : Fries, 1823, Systema Mycologicum 2: 12.

≡*Morchella caroliniana* Bosc, 1811, Gesellschaft Naturforchender Freunde Berlin. Sitzungsberichte 5: 86.

≡*Elvela caroliniana* (Bosc) Nees, 1817, Das System der Pilze und Schwämme p. 176.

(additional synonyms see McKnight 1973; Weber 1988).

Type Material: Neotype (designated McKnight 1973) BPI, examined.

Distribution: Found in southeastern North America (McKnight 1973; Weber 1988). *G. caroliniana* is reported by Larsen and Denison (1978) from BC, WA, and OR, but all specimens from UBC and WTU examined in this study are assigned to *G. gigas* here. Reports from Europe are unsubstantiated and are due to confusion with *G. fastigiata* and *G. gigas*.

Notes: The species concept of *G. caroliniana* has been the source of much confusion, but the concept accepted here is based on the neotype selected by McKnight (1973), which we believe corresponds to that of Bosc (1811) and Fries (1823, 1871).

Collections Examined: **USA: Indiana:** Greencastle, Banker (1318) 04 28 1909, NY. **Virginia:** Lorton, Bland 04 24 1942, BPI (neotype). **North Carolina:** Curtis 2247, Herb. Berkeley 1879, K.

Gyromitra fastigiata (Krombholz) Rehm, 1896, Die Pilze, in Rabenhorst, Kryptogamen-Flora von Deutschland, Österreich und der Schweiz, 2nd ed. 1: 1194.

≡*Elvela fastigiata* Krombholz, 1834, Naturgetreue Abbildungen und Breschreibungen der essbaren, schädlichen und verdachtigen Schwämme 3: 28.

≠*Gyromitra fastigiata sensu* Mcknight, 1971 (=*G. gigas*).

=*Gyromitra brunnea* Underwood, 1894, Proceedings Indiana Academy of Science 1893: 33. (lectotype and authentic material NY, examined).

≡*Elvela underwoodii* Seaver,1928, The North American Cup-Fungi (Operculates) p. 254 (*nomen novum*); non *Elvela brunnea* Linnaeus. (*fide* McKnight 1973).

(additional synonyms see Weber 1988).

Type Material: none available (*fide* McKnight 1971).

Distribution: This species is known from eastern and southern North America (McKnight 1973, as *G. brunnea*; Weber 1988) and Europe (Svrcek and Moravec 1972; Ryman 1979; Krieglsteiner 1981; Kotlaba and Pouzar 1974). *G. fastigiata* reported from AB by Larsen and Denison (1978) follows nomenclature of McKnight (1971) and is a synonym of *G. gigas* (q.v.).

Notes: The species concept has been variously interpreted (McKnight 1971; Svrcek and Moravec 1972) due to the rather imprecise original description by Krombholz (1831-1846) and the lack of extant type material. After examination of the original publication, we accept the concept outlined by Svrcek and Moravec (1972) in agreement with Harmaja (1973) and Weber (1988). A neotype from the type locality is required.

Collections Examined: **CANADA: Ontario:** Terra Nova, Van Gerwin 05 31 1981, TRTC 49016; Halton Forest near Campbellville, Thompson (JFA 8363) 05 9 1978, WTU; Rondeau P.P., Hutchison 05 9 1987, TRTC. **USA: Iowa:** Iowa City, Kennedy 04 26 1955, ALTA 668, 669, 670. **Indiana:** Greencastle, Underwood 05 1892, 1893, 1894, NY (Lectotype of *Gyromitra brunnea*); Greencastle, Banker (3832) 04 21 1911, NY; near Fern, Banker (1344) 03 4, 8 1910, NY. **Ohio:** Red Bank near Cincinnati, Lloyd 04 21 1895, NY.

Gyromitra parma (J. Breitenbach & Maas Geesteranus) Kotlaba & Pouzar, 1974, Ceská Mykologie 28: 84-95.

≡*Discina parma* J. Breitenbach & Maas Geesteranus, 1973, Proceedings. Koninklijke Nedelandse Akademie van Wetenschappen. Series C. Biological and Medical Science 76: 101-108.

Type Material: Holotype L, examined; isotype K, examined.

Fig. 39.

Distribution: *G. parma* is found only in central Europe (Breitenbach and Maas Geesteranus 1973; Breitenbach and Kränzlin 1981; Bregazzi 1978; Hocevar 1978,1982).

Notes: This species is separated from the others in the subgenus by its subsessile, irregularly cupulate, apothecia. The apical spicules are more highly developed than in others of the subgenus (Fig. 39).

Collections Examined: SWITZERLAND: Kanton Obwalden, near Grafenort, von Büren 05 19 1972, L (holotype), K (isotype).

Gyromitra Subgenus *Discina* (Fries) Harmaja, 1973, Karstenia 13: 56, *emend. nov.*

Type species: *Gyromitra perlata* (Fries) Harmaja, 1969, Karstenia 9: 11.

Ascocarp: sessile to stipitate, cupulate, discoid, convex, or irregularly lobed; hymenium yellow brown, orange brown, red brown, to dark brown, undulate-rugose to convoluted-wrinkled. **Ascospores:** ellipsoidal to fusoidal, uniguttulate to triguttulate, appearing distinctly roughened with light microscope, with SEM spores coarsely rugose with anastomosing ridges forming an irregular reticulum, solitary polar apiculi virtually lacking to well developed.

Notes: Fries (1823) treated *Discina* as a subgeneric taxon of *Peziza*, but later (Fries 1849) gave *Discina* generic status. Harmaja reduces *Discina* to a subgenus of *Gyromitra* and notes that the lectotype was indirectly selected by Fries (1849) by restricting *Discina* to a monotypic taxon including only *D. perlata*. The subgenus *Discina* contains subsessile to distinctly stipitate species with highly ornamented spores and solitary apiculi. These may be slight inflations of the perispore (Figs. 32, 37, 38), or well developed and knob-like (Figs. 35, 36), pointed (Figs. 31, 33), or depressed (Fig. 34). The surface ornamentation develops slowly and may be incomplete on submature but viable spores ejected from the asci as described by Donadini (1986a). At maturity the spores are prominently and irregularly rugose with anastomoses between ridges which form an irregular close reticulum (Figs. 32-35, 38). The subgenus is emended to exclude taxa with coarsely reticulate ascospores and apical spicules (subgenus *Caroliniana* here).

Key to species of *Gyromitra* subgenus *Discina*

1. Ascospore apiculi depressed (concave); fresh hymenium bright yellow brown to orange brown.. ***G. leucoxantha***
1'. Ascospore apiculi broadly rounded, knob-like, or pointed; fresh hymenium yellow brown, orange brown, red brown, or brown 2
  2. Ascospore apiculi pointed; fresh hymenium red brown to dark brown...***G. perlata***
  2'. Ascospore apiculi broadly rounded or blunt knob-like projections; fresh hymenium yellow brown to orange brown....................................3
3. Ascocarps stipitate; ascospore apiculi indistinct and broadly rounded to distinct and knob-like...***G. gigas***
3'. Ascocarps sessile; ascospore apiculi indistinct and broadly rounded...***G. olympiana***

Gyromitra gigas (Krombholz) Quélet, 1873, Les Champignons du Jura et des Vosges. 2: 382.

≡*Elvela gigas* Krombholz, 1834, Naturgetreue Abbildungen und Breschreibungen der essbaren, schädlichen und verdachtigen Schwämme 3: 28.

=*Gyromitra montana* Harmaja, 1973, Karstenia 13: 56. (holotype H, examined; isotypes BPI, K, examined)

=*Discina korfii* Raitviir, 1970, Tartu riikliku ülikooli toimetised 268. Botaanika-alased tõõd 9: 371. (paratype CUP, examined).

≡*Gyromitra korfii* (Raitviir) Harmaja, 1973, Karstenia 13: 56.

Type Material: none available (*fide* McKnight 1971).

Figs. 2a, 35-38.

Apothecium: 30-65 mm diam., 20-70 mm high (up to 140 x 90 mm fresh), irregularly lobed, convex, appressed and fused to stipe, although some apothecial lobes may be free, hymenium yellow brown to orange brown fresh, medium to dark brown when dried, undulate-rugose, excipular surface cream to yellow brown, smooth or with broadly rounded ribs continuous with those of the stipe, glabrous to finely pubescent. **Stipe:** 10-75 x 15-60 mm (up to 130 x 100 mm fresh), robust, enlarged at base, white or cream to greyish brown with pink tints, pubescent, nearly smooth or typically fluted, with broadly rounded ribs, internally chambered. **Asci:** 400-450 x 13.0-24.0 μm. **Paraphyses:** 4.5-11.0 μm diam. at apex, terminal cell 35-60 μm long, clavate, enlarged gradually to abruptly at apex, brown, contents coarsely granular. **Ascospores:** 26.0-39.8 x 11.6-14.8 μm, ellipsoidal, subfusoidal, to fusoidal, hyaline, slightly to distinctly roughened, with SEM spore surface finely to coarsely rugose, ornamentation of individual ridges or anastomosing to form incomplete or complete reticulum, apiculus nearly absent to prominent, 1.0-5.8 μm long, broadly rounded thickening to distinct blunt knobs, very rarely depressed; uniguttulate to triguttulate, with one large globose to broadly ellipsoidal central guttule and 0-2 smaller globose polar guttules.

Habitat: Solitary to gregarious on litter and woody debris in coniferous or mixed woods, often near melting snow. Associated trees: *Picea glauca, Pinus contorta, Abies lasiocarpa, Abies grandis, Abies balsamea, Pseudotsuga menziesii, Thuja plicata, Populus tremuloides, Populus balsamifera, Betula papyrifera, Betula occidentalis, Alnus* sp., and *Acer* sp. Associated shrubs: *Betula pumila* and *Salix* sp. Fruiting from April 3 in WA to July 13 in AK. June collections are most common.

Distribution: Widely distributed in boreal, montane and coastal regions from AK, NWT, BC, AB, WA, ID, OR, and WY. Reported from MT (McKnight 1971). Also in eastern North America (Weber 1988 as *G. korfii* and *G. montana*; Ginns 1975 as *Discina korfii*), Europe (Dennis 1978; Breitenbach and Kränzlin 1981), and Asia (Imai 1954, as *Neogyromitra gigas*). Map 5.

Notes: The concept and limitations of this species are unclear because of an inadequate original description lacking in microscopic data. Our concept agrees with Svrcek and Moravec (1972). Two closely related species *G. montana* (Harmaja 1973) and *Discina korfii* (Raitviir 1970) are considered conspecific. *Gyromitra korfii* was erected for North American specimens with prominently apiculate, fusoidal ascospores which are slightly narrower and shorter (29.2-37.3 x 9.7-12.0 μm, Raitviir 1970) than European specimens. Spores of *G. korfii* are more delicately reticulate and paraphyses expanded more abruptly to 13 μm diam. (Harmaja 1973). In North American material examined, paraphyses do not exceed 11 μm diam., and are no more distinctly capitate than European material. Spores by SEM vary from finely to coarsely rugose or reticulate in both North American and European material, supporting observations (Donadini 1986a) that finely ornamented spores are often ejected from submature ascocarps. The same variation in ornamentation is also observed in *G. perlata* and *G. olympiana*. The spores differ only slightly in size, and cannot be used to distinguish *G. korfii* from *G. gigas* (*sensu stricto*). The species should be considered conspecific even if subtle differences exist between European and North American material. *Gyromitra montana*, recognized by McKnight (1971) as *G. gigas*, was later renamed by Harmaja (1973) after a reevaluation of the original concepts of *G. gigas* and *G. fastigiata*. *Gyromitra montana* has "slightly more ellipsoid, less fusoidal spores with somewhat broader ends, inconstancy of the spore apiculi, variable and often irregular shape and smaller size of the latter when discernable, slightly more delicate ornamentation of the perispore, thicker tips of the paraphyses which may even be capitate and attain a breadth of 13 µm, earlier fruiting time often near melting snow, and different distribution in the mountains of western North America and Austria in Europe" (Harmaja 1973). Paraphyses do not differ in size from *G. korfii* (Harmaja 1973), in which spore size is more similar to *G. gigas* of Europe than to *G. montana*. The more delicate perispore ornamentation is rejected because coarsely ornamented spores from collections otherwise typical of *G. montana* have been observed (Fig. 38), and because of the variability of spore ornamentation in other related species as discussed above (compare Figs. 35-38) and by Donadini (1986a). Ascospore shape and apiculation are perhaps the most diagnostic characters but the features overlap. In most collections typical of *G. montana*, including the type, some spores are subfusoidal and distinctly apiculate. In addition, some collections examined from the study area have both spore morphologies in approximately equal proportions (e.g., WTU Stz 17345). No macroscopic features have been found which distinguish these taxa. These taxa should be accepted as conspecific with a rather broad range of ascospore morphology.

Collections Examined: **CANADA: Northwest Territories:** Hay River, Green 07 1 1986, UVIC. **British Columbia:** Illicilwaet River, Glacier N.P., Abbott 06 9 1988, ALTA 8443; near Bolean Lake, Falkland, Ziller 06 8 1966, DAOM 116828; Cook Creek north of Qualicum, Vancouver Island, Lisson 05 5 1972, UVIC; Honeymoon Bay south of Cowichan Lake, Vancouver Island, Melburn 04 22 1967, DAOM 124683; Manning P.P., Flegel 06 20 1968, UBC F1327, F1330, DAOM 176039. **Alberta:** Carson-Pegasus P.P., Abbott (SA 762) 05 15 1993, SA; Poplar Creek Natural Area near Breton, Osis (SA 667) 05 24 1993, SA; Burnt Timber Creek on Forestry Trunk road, Danielson (RMD 1423) 07 10 1974, ALTA; Sheep River, Danielson (RMD 1385) 06 9 1974, ALTA; Cypress Hills P.P., Currah 05 6 1987, ALTA 8324; Cypress Hill P.P., Danielson (RMD 1944) 06 1 1976, ALTA. **Ontario:** south lookout trail, Algonquin P.P., Ammirati (JFA 8368) 05 16 1979, WTU. **USA: Alaska:** Thunderbird Falls trail north of Anchorage, Kempton 05 22 & 06 8 & 15 1961, 06 8 & 15 1966, WK 1590, 1591, 1593, 1600, 1602, 1603; Anchorage, Kempton 05 29 1960, 06 5 1961, 06 22 & 28 & 07 6 1972, 05 29 1990, WK 1597, 1592, 5798, 5799, 6740; Indian, south of Anchorage, Kempton 05 16 1960, WK 1598; south of Bird Flats, Kempton 05 22 1967, WK 1607; north of Palmer, Kempton 07 13 1971, WK 5041; Finger Lake near Palmer, Kempton 06 2 1970, 06 12 1973, WK 4391, 5265; Resurrection Pass trail, Kenai Peninsula, Kempton 06 3, 9 1973, WK 5264, 5266; Lower Russian Lake trail, Kenai Peninsula, Kempton 06 16 1973, WK 5268. **Washington:** Everett, Clark 04 1950, WSP CS25643; Lake Wenatchee State Park, (Stz 13569) 05 22 1966, WTU; Skykomish, Wells (Stz 17345) 05 11 1972, WTU; Skykomish, Koch 04 3 1947, WSP 23882; below Keechelus Lake, Brough (21) 05 5 1956, WTU; Liberty, Retnam (Stz 1885) 05 4 1946, WTU; Tacoma, Griggs 05 22 1933, WTU; Tumwater Forestry camp, (Stz 14177) 05 21 1967, WTU; Teal Spring, Umatilla National Forest, Garfield Co., Shaw 06 5 1948, WSP CS25657; Teanaway, Dilly (Stz 18286) 05 5 1974, WTU; Stampede Pass, (Stz 13180) 07 1964, WTU; White Chuck River campground, Maguire, WTU; unknown, (Stz 1211, 1215), Quinby (22F), WTU. **Idaho:** Hayden Lake area, Chariton 05 10 1989, WTU; east of Viola, Damsteegt 05 27 1959, WSP 49134; east of Viola, Shaw 05 21 1948, WSP CS17387; west end of Thatuna Ridge, Latah Co., Cooke 05 16 1947, WSP 24508; Goose Lake, New Meadows, Jeanne & Smith 07 3 1962, DAOM 191998; French Creek Summit near McCall, Miller 07 12 1964, WSP 54594; Brundage Reservoir, Miller 06 20 1964, WSP 54304. **Oregon:** Mt. Ashland near Ashland, Isaacs (Is 1777) 06 10 1962, WTU; east of MacDougall Camp, Umatilla Co., Cooke 05 16 1947, 06 17 1948, WSP 24508, 19870; south of Spout Springs, Umatilla National Forest, Blue Mountains, Union Co., Cooke 06 17 1948, WSP 19872; Horseshoe Meadows, Blue Mountains, Wallowa Co., Cooke 06 10 1949, WSP AS31819. **Wyoming**: west side of Teton Pass, Teton Co., McKnight (KHM 10351) 06 24 1967, H (holotype of *G. montana*) BPI, K (isotypes); Medicine Bow Mountains, Carbon Co., Solheim & Cronin 07 3 1950, DAOM 114944. **North Carolina:** north of Greensboro, Whetzel 05 4 1940, CUP 28997 (paratype of *G. korfii*). **SWEDEN:** Upland, Bösslinge Skog, south of Börje near Uppsala, Lundell 05 15 1945, K. **FINLAND:** Varsinais-Suomi, Lohja rural commune, Harmaja 06 6 1972, H. UNKNOWN: Wynne 03 1874, Herb. Berkeley, K.

Gyromitra leucoxantha (Bresadola) Harmaja, 1969, Karstenia 9: 11.

≡*Discina leucoxantha* Bresadola, 1882, Revue de Mycologie 4: 212.

=*Discina leucoxantha* var. *fulvescens* Rea, 1928, Transactions of the British Mycological Society 13: 254. (isotype BPI, examined).

=*Discina larryi* McKnight, 1974 The Michigan Botanist 13: 52. (holotype BPI, examined).

≡*Gyromitra larryi* (McKnight) Harmaja, 1976, Karstenia 15: 30.

=*Discina convoluta* Seaver, 1921, Mycologia 13: 70. (*fide* McKnight 1969).

Type Material: Holotype S, examined; isotype K, examined.

Fig. 34.

Apothecium: 10-35 mm diam., 5-15 mm high (up to 65 x 20 mm fresh), irregularly cupulate to reflexed, hymenium orange brown to bright orange brown fresh, when dry bright red brown, undulate-rugose, excipular surface white to pallid brown, pubescent, smooth or with few ribs at base. **Stipe:** usually distinct, often buried in substratum, 5-15 x 5-10 mm (up to 25 x 15 mm fresh), equal, flaring and merging with apothecium, white to pallid brown, pubescent, fluted, ribs broadly rounded, solid. **Asci:** 19.1-22.3 µm diam. **Paraphyses:** 6.4-9.0 µm diam. at apex, clavate, gradually enlarged to abruptly swollen at apex, brown, contents coarsely granular. **Ascospores:** 25.9-31.1 x 11.1-13.9 µm, subfusoidal to fusoidal, hyaline, distinctly roughened to reticulate, with SEM spore surface of coarse rugose wrinkles or anastomosing to form reticulum, apiculi prominent, 1.5-2.8 µm long, with depressed (concave) apiculi at maturity, submature spores with slight apical thickenings, truncate knobs, or small depressed apiculi; uniguttulate to triguttulate, with one large central globose to ellipsoidal guttule, with 0-2 smaller globose polar guttules.

Habitat: Solitary to gregarious on soil, litter, or woody debris in coniferous woods. Associated trees: *Abies lasiocarpa, Picea glauca, Pinus contorta, Pseudotsuga menziesii, Thuja plicata*, and *Populus balsamifera*. Associated shrubs include *Alnus crispa, Acer glabrum* and *Berberis repens*. Fruiting from May 10 to June 8 in BC.

Distribution: Rare in montane forests from BC and AB. This species is newly reported for AB and BC. It is known from ID and OR (Larsen and Denison 1978), and is also in eastern North America (Ginns 1974d; Weber 1988; Seaver 1921) and Europe (Breitenbach and Kränzlin 1983; Ryman 1979, Rea 1928). Map 5.

Notes: This species is easily distinguished from others in the subgenus on the basis of the unique depressed apiculus, although spores of *G. gigas* (q.v.) are rarely depressed. Spore ornamentation places the species in this subgenus along with *G. perlata* (q.v.), *G. gigas*, and *G. olympiana* (q.v.). Due to similarities in ascocarp coloration, spore ornamentation and apiculation, and the short stipe, *G. leucoxantha* may be most closely related to *G. gigas*, although the species are easily recognized and considerably isolated taxonomically. Variety *fulvescens*, described by Rea (1928) for darker orange brown specimens (rather than the typical bright yellow to yellow brown hymenium coloration originally described), has no other correlative features. Fresh specimens from southern Alberta exhibited orange brown hymenia, but since ascocarp coloration is variable in other taxa, such as *G. gigas* and *G. olympiana*, there is little support for maintaining this taxon above a form level. *Gyromitra larryi* was differentiated from *G. leucoxantha* on the basis of less pronounced spore ornamentation and small depressed apiculi (McKnight and Batra 1974). After examination of the holotype, the specimens appear to represent submature individuals of *G. leucoxantha*, and we therefore consider *G. larryi* a synonym. Most asci were immature, and most spores lacked the typical apiculus and reticulate ornamentation, but several mature spores found were typical for *G. leucoxantha*. Submature spores may be ejected from the asci before ascocarp maturity (Donadini 1986a) and could have been collected for SEM examination using the methods employed by McKnight and Batra (1974). The bright red brown dried hymenium typical of *G. leucoxantha* is also present in the type of *G. larryi*.

Collections Examined: CANADA: British Columbia: Giant Cedars, Mount Revelstoke N.P., Egger (1026) 06 8 1985, DAOM 199539; Kootenay Lake near Procter, Linton 05 10

1978, UVIC. **Alberta:** Crandell Lake, Waterton Lakes N.P., Abbott (SA 320) 05 27 1990, SA; Upper Waterton Lake trail, Waterton Lakes N.P., Abbott (SA 336) 05 28 1990, SA. **USA: Utah:** west portal of Duchesne Tunnel, Summit Co., McKnight (KHM 11777) 05 29 1970, BPI (holotype of *G. larryi*). **UNITED KINGDOM:** near Perth, Scotland, Menzies 05 12 1924, BPI (holotype of *G. leucoxantha* var. *fulvescens*). **ITALY:** Bresadola, S (holotype), K (isotype).

Gyromitra olympiana (Kanouse) Harmaja, 1973, Karstenia 13: 56.

≡*Discina olympiana* Kanouse, 1947, Mycologia 39: 648.

=*Discina olympiana* var. *diluta* McKnight, 1969, Mycologia 61: 625. (holotype BPI, examined).

=*Discina apiculatula* McKnight, 1969, Mycologia 61: 616. (holotype BPI, examined).

≡*Gyromitra apiculatula* (McKnight) Harmaja, 1973, Karstenia 13: 56.

Type Material: Holotype MICH (unavailable for loan).

Figs. 2b, 32.

Apothecium: 9-50 mm diam., 10-15 mm high (up to 54 x 25 mm fresh), deeply to shallowly cupulate to discoid or reflexed, margin inrolled initially, margin rarely splitting in age, hymenium (fresh) pale to dark yellow brown to brown or red brown in age, sometimes with olivaceous tints, dark brown when dried, smooth to undulate-rugose, excipular surface cream to pallid brown, glabrous to pubescent, leathery. **Stipe:** lacking to rudimentary, up to 4 x 4 mm (to 20 x 20 mm fresh), flaring and merging with apothecium, cream to whitish brown, smooth or slightly fluted, finely pubescent, solid. **Asci:** 16.7-26.6 µm diam. **Paraphyses:** 5.6-13.1 µm diam. at apex, terminal cell 84-218 µm long, clavate to irregularly lobed, gradually enlarged or abruptly swollen at apex, sometimes bent or branched at apex, when present branches bifurcate at apex or paraphyses with knob-like branch bud below primary apex, yellow brown, brown in mass, contents coarsely granular. **Ascospores:** (24.4) 27.2-39.8 (40.7) x (10.7) 12.0-17.6 (19.5) µm, ellipsoidal to subfusoidal or fusoidal, hyaline, finely roughened, with SEM spore surface finely to coarsely rugose, wrinkles isolated or anastomosing into incomplete reticulum, apiculi virtually absent or broadly rounded thickenings, sometimes distinct broad truncate knobs, uniguttulate or less frequently triguttulate, large globose central guttule, with 0-3 smaller globose polar guttules.

Habitat: Solitary, gregarious, or scattered on soil or duff in coniferous forests or mixed woods, frequently near melting snow. Associated trees: *Abies lasiocarpa, Pinus contorta, Picea glauca, Pseudotsuga menziesii, Populus balsamifera, Populus tremuloides*. Associated shrub: *Alnus crispa*. Fruiting from May 17 in OR to June 24 in WY.

Distribution: Infrequent in montane regions from BC, AB, WA, OR, and WY. This species is newly reported for BC and AB. Also known from eastern North America (McKnight 1969). The identity of specimens reported as *G. apiculatula* from Europe (Donadini 1986a) is not confirmed. Map 3.

Notes: Spore ornamentation and apiculation, ascocarp colour, and habitat suggest affinity with *G. gigas* (q.v.), while ascocarp morphology is more similar to *G. perlata*. McKnight (1969) relies on the presence of the unique branching paraphyses to separate this species from *G. apiculatula*. However, this varies within and among collections. Irregular or branched paraphyses are often restricted to isolated regions on an ascocarp. Also, McKnight (1969) erected var. *diluta* which he described as having unbranched paraphyses. We rarely observe apically branched paraphyses in *G. ambigua* (q.v.). Furthermore, other features that were correlated with paraphysis morphology, including size and coloration of the ascocarp (McKnight 1969), do not correlate in our investigations. The variation in ascospore size within and among collections exceeds the subtle differences noted in *G. olympiana* and *G. apiculatula* by McKnight (1969).

Collections Examined: CANADA: British Columbia: Illicilwaet River, Glacier N.P., Abbott 06 9 1988, ALTA 8442; Lightning Lakes trail, Manning P.P., Egger (2022) 06 9 1985, DAOM 199544. **Alberta:** Watridge Lake area, Kananaskis country, Danielson (RMD 3815) 06 9 1991, ALTA; Lineham Creek area, Waterton Lakes N.P., Abbott (SA 319) 05 26 1990, SA; Rowe Lake trail, Waterton Lakes N.P., Abbott (SA 325, 326, 329, 331) 05 27 1990, SA; Bauerman Creek trail, Waterton Lakes N.P., Abbott (SA 334) 05 28 1990, SA. **USA: Washington:** Cascade Christian Camp, Ammirati (JFA 9297), WTU; Stampede Pass, Dassow (Stz 16007) 06 1 1970, WTU. **Oregon:** Hood River Co., Sieger 05 17 1986, WTU. **Wyoming**: west of Teton Pass, Teton Co., McKnight (KHM 10340) 06 24 1967, BPI (type of *G. olympiana* var. *diluta*). **Utah**: north of Aspen Grove, Utah Co., McKnight (KHM F5477) 06 5 1962, BPI (holotype of *G. apiculatula*).

Gyromitra perlata (Fries) Harmaja, 1969, Karstenia 9: 11.

≡*Peziza perlata* Fries, 1823, Systema Mycologicum 2: 43.

≡*Discina perlata* (Fries) Fries, 1849, Summa Vegetabilium Scandinaviae 2: 348.

=*Gyromitra macrospora* (Bubák) Harmaja, 1973, Karstenia 13: 56. (lectotype BPI, examined; authentic material BPI, examined).

=*Gyromitra fluctuans* (Nylander) Harmaja, 1986, Karstenia 26: 42. (*fide* McKnight 1969; Harmaja 1986)(see notes).

=*Gyromitra warnei* (Peck) Harmaja, 1973, Karstenia 13: 56. (holotype NYS, examined; isotype K, examined).

?=*Gyromitra mcknightii* Harmaja, 1986, Karstenia 26: 42. (see notes).

(additional synonyms see Harmaja 1973, 1986; Weber 1988).

Type Material: unknown (*fide* McKnight 1969).

Figs. 2c, 31, 33.

Apothecium: 8-70 mm diam., 3-20 mm high (to 120 x 40 mm fresh), shallowly cupulate, discoid, or reflexed, margin inrolled initially, hymenium red brown to medium or dark brown fresh, dark brown to blackish brown when dried, nearly smooth or typically undulate-rugose, excipular surface white to cream or pale grey brown, nearly glabrous to pubescent, leathery when dried, smooth or somewhat ribbed near stipe, ribs rarely extending onto three quarters of excipular surface. **Stipe:** virtually lacking or with a thickened base to distinct, up to 45 x 25 mm (to 30 mm diam. fresh), flaring and merging with apothecium, white to cream or pale red brown, nearly glabrous to pubescent, typically fluted with broadly rounded ribs, solid or with few chambers. **Asci:** 350-375 x 17.0-25.0 µm. **Paraphyses:** 5.1-10.7 µm diam. at apex, terminal cell 64-103 µm long, clavate, gradually enlarged to abruptly swollen, brown individually, dark brown in mass, contents coarsely granular. **Ascospores:** 27.6-45.6 x 11.6-16.1 µm, subfusoidal to fusoidal, hyaline, nearly smooth to distinctly roughened at maturity, with SEM spore surface coarsely rugose to reticulate, apiculi well developed, pointed, 1.7-5.4 µm long, some spores rarely non-apiculate; uniguttulate to triguttulate, large central guttule globose to broadly ellipsoidal, with one or two small globose polar guttules.

Habitat: Solitary, gregarious or subcaespitose and numerous, scattered on soil, litter, or woody debris, less frequently on rotted wood or burnt debris, under conifers or rarely in deciduous or mixed woods. Associated trees: *Picea glauca, Picea engelmannii, Pinus contorta, Abies lasiocarpa, Abies balsamea, Pseudotsuga menziesii, Tsuga* sp., *Thuja plicata, Populus balsamifera, Populus tremuloides, Alnus* sp., and *Betula papyrifera*. Associated shrubs: *Acer glabrum, Acer circinatum, Salix* sp., *Vaccinium* sp., and *Rosa* sp. Fruiting from March 27 in coastal WA to July 10 in AB. May and June collections are typical. March and early April collections are known from southern coastal regions.

Distribution: Widely distributed in boreal, montane, and coastal forests from AK, BC, AB, SK, MB, WA, ID, OR, and WY. Also in eastern North America (Weber 1988; Seaver 1928, as *Discina ancilis*) and Europe (Breitenbach and Kränzlin 1981; Graddon 1976). Map 4.

Notes: This species constitutes *G. perlata sensu lato*. Forms deviating in apiculus size and shape, as well as slight differences in spore size, are not considered distinct at the specific level. Thus, *G. macrospora* and *G. warnei*, recognized as distinct by many recent authors (McKnight 1969; Ginns 1974c) are considered synonyms. This agrees with the concept of Seaver (1928). Weber (1988) also raises doubts about these species because they are indistinguishable macroscopically. In addition, many collections examined in this study show considerable variation and intermediate microscopic features. *Gyromitra macrospora* is reported to differ from *G. perlata sensu stricto* in its large apiculi (3.5-5 µm long in McKnight 1971) and more fusoidal ascospores, while *G. perlata* has short apiculi (1-3 µm long in McKnight 1971) from subfusoidal spores. Many collections from the study area show apiculi 2-4 µm long and spore shape can vary (even within an individual ascocarp) from subfusoidal to fusoidal. Spore shape is also influenced by the degree of apiculation and these characters are not independent. Harmaja (1986) has recently synonymized *G. macrospora* with the older *G. fluctuans* and has described the new species *G. mcknightii* with apiculi intermediate between *G. perlata* and *G. macrospora*. We have not examined the types but they would likely be synonymous with *G. perlata sensu lato* as described here.

Collections Examined: **CANADA: British Columbia:** Revelstoke, Ziller 06 8 1950, DAOM 33248; Summit Trail, Mount Revelstoke N.P., Shoemaker 06 23 1986, DAOM 195910; south of Spillimacheen, Parmelee 05 20 1969, DAOM 128524; Kindensly Creek, Kootenay N.P., Rushton 06 16 1969, UVIC; Procter, Linton 05 7 1977, UVIC; Cowichan Lake, Vancouver Island, Ziller 05 15 1948, DAOM 26093; Ladysmith, Vancouver Island, Bandoni 04 18 1960, UBC F3220; Victoria, Vancouver Island, Hockley 04 16 1964; Bedford road woods, Vancouver Island, Melburn 04 20 1957, DAOM 56641; Saturna Island, VMS 04 7 1985, UBC F12435; Grouse Mountain, North Vancouver, UBC F3221; Lynne Valley, North Vancouver, Waugh 04 19 1952, DAOM 29520; Point Grey, Vancouver, Barr 05 11 1952, UBC F3219; Ford Lookout trail, Chilliwack, Rabas 05 16 1971, UBC F3222; Lightning Lake trail, Manning P.P., Egger (2034, 2039) 06 9 1985, DAOM 199555, 199560; Paxton Valley, Ginns 06 4 1968, DAOM 129267, K. **Alberta:** near Hondo, Kennedy 05 5 1983, ALTA 8150; Carson-Pegasus P.P., Abbott (SA 763) 05 15 1993, SA; Wagner Natural Area, Abbott (SA 747) 05 9 1993, SA; near Edmonton, Moss 05 27 1927, DAOM 2988; Devonian Botanic Garden near Devon, Abbott (SA 27) 05 1987, SA; Forest Reserve Boundary on Forestry Trunk road 40 km from Trans-Canada highway, Danielson (RMD 1420) 07 10 1974, ALTA; Marmot Creek, Kananaskis Valley, Danielson (RMD 2025) 07 5 1976, ALTA; Brown-Lowery Natural Area, Danielson (RMD 739, 758, 763, 764, 768, 2545) 06 14 & 19 1973, 06 5 1977, ALTA; Fish Creek P.P., Calgary, Danielson (RMD 27) 06 9 1972, ALTA; Glenmore Park, Calgary, Danielson (RMD 32) 06 7 1972, ALTA; Sheep River, Danielson (RMD 1380, 1382) 06 9 1974, ALTA; Blackiston Falls Trail, Waterton Lakes N.P., Abbott (SA 342, 344) 05 29 1990, SA; Upper Waterton Lake trail, Waterton Lakes N.P., Abbott (SA 337, 345) 05 28 1990, SA; Cypress Hills P.P., Danielson (RMD 1958, 1964) 06 2 & 3 1976, ALTA. **Saskatchewan:** Prince Albert N.P., Zelmer (PA 2, 469) 1994 & 1995, ALTA. **Manitoba:** Victoria Beach, Lake Winnipeg, Bisby 06 2 & 13 1928, DAOM 156564, 156990, 206827, 206828; Grand Marais, 05 29 1969, CFB WINFM 11342, 11381, 11382c; Lac du Bonnet, Bisby 06 6 1935, DAOM 206826. **USA: Alaska:** Anchorage, Kempton 06 5 1959, 06 20 1973, WK 1121, 5273; Beaver Lake near Palmer, Kempton 06 15 1967, WK 1135; butte area on old Palmer highway, Kempton 06 29 1961, 06 18 1962, 06 22 1967, WK 1126, 1127, 1136; Glacier campground, Matanuska valley, Kempton 06 15 1971, WK 4872. **Washington:** Glacier, Paden (JWP 696, 698) 05 5 1969, UVIC; Friday Harbor, San Juan Island, Brough (Is 62) 04 21 1967, WTU; San Juan Campground, Garland Spr. area, (Stz 14189) 05 27 1967, WTU; Twisp, Benedict (Stz 17341) 05 21 1972, WTU; Lake Wenatchee State Park, NC (Stz 6236) 05 27 1951, WTU; east of Skykomish, Cohen (Stz 6710), WTU; near Greenacres, Deuton (Stz 21647) 04 27 1982, WTU; Seattle, Ammirati (JFA 9897) 03 27 1989, WTU; Seattle, Stuntz 05 1980, WTU; Seattle, Zeller (245), WTU; Seattle, CRS 03 1916, WTU; Watermain Woods, Richmond, (Stz 18237) 04 28 1974, WTU; between Snoqualmie Pass and Keechelus Lake, Isaacs (Is 1678) 05 12 1962, WTU; near Keechelus Lake, Stuntz (Is 1733b), WTU; Kachess Lake, Isaacs (Is 1669) 05 6 1962, WTU; Cle Elum, Snyder (95) 05, WTU; Olympia, Snyder (95) 03, WTU; south of Olympia, McKenny (Stz 13488) 03 1966, WTU; Tumwater Forestry Camp, (Stz 6215) 04 30 1951, WTU; between Burnett and Wilkeson, Isaacs (Is 1659) 05 7 1962, WTU; Ewartsville, Duran 05 1 1983, WSP 67338; Lee Forest near Maltby, Cohen (Stz 6699) 05 3 1952, WTU; Lee Forest near Maltby, Stuntz (Is 1653) 04 29 1962, WTU; Lee Forest near Maltby, Brough (20) 04 25 1956, WTU; Indian Creek, upper Teanaway, Stuntz (Stz 6223) 05 13 1951, WTU; divide between West and Middle Fork, Teanaway River, van de Bogart 05 10 1980, WTU; lower Jack Creek, Teanaway, van de Bogart 05 10 1980, WTU; Teanaway, Dilly 04 30 1978, WTU; Teanaway, (Stz 16650) 06 20 1971, WTU; Fish Lake, 04 19 1981, WTU; West Mountain road, Ammirati (JFA 9270) 06 12 1986, WTU; Novelty Hill road, White (Stz 20313) 04 7 1978, WTU; unknown, Volz (Stz 14751) 06 1968, Puget Sound Mycological Society (Stz 15447) 05 11 1969, (Stz 17875) 05 1973, WTU. **Idaho:** Sagle, van de Bogart (FVB 3523) 06 1975, WTU; Thatuna Ridge, Latah Co., Hisil 04 29 1964, WSP 56317; Thatuna Ridge, Latah Co., Paden 05 4 1964, WSP 56311. **Oregon:** Crater Lake N.P., Cooke 06 28 1972, MU F26575. **Wyoming:** Teton Co., Mcknight (10273) 06 12 1967, DAOM 146504. **New York:** Oneida, Warne 1874, NYS (holotype of *G. warnei*), K (isotype). **CZECHOSLOVAKIA:** Bohemia, Tábor, Búbak 04 29 1904, BPI (lectotype of *G. macrospora*); Bohemia, Tábor, Búbak 04 23 1905, BPI. **Exsiccata**: Solheim, Mycoflora Saximontanensis Exsiccata, 1539, Medicine Bow National Forest, WY, USA, Solheim 06 25 1970, s.n. *Discina ancilis.*

Gyromitra Subgenus *Gyromitra*

Type species: *Gyromitra esculenta* (Persoon) Fries, 1849, Summa Vegetabilium Scandinaviae 2: 346.

Ascocarp: distinctly stipitate; apothecium irregularly convex, irregularly lobed; hymenium orange brown to dark red brown, undulate-rugose to highly convoluted; excipular surface felty pubescent to nearly glabrous. **Ascospores:** narrowly ellipsoidal, ellipsoidal, or subfusoidal, biguttulate, appearing smooth with LM, but finely rugose with SEM, non-apiculate or with broadly rounded, inflated apiculi.

Notes: The subgenus has biguttulate, ellipsoidal to narrowly ellipsoidal or narrowly subfusoidal ascospores. Apiculi are absent or present as rounded swellings of the perispore. Spore ornamentation is indistinct with the LM, but finely rugose by SEM (Figs. 29, 30).

Key to species of *Gyromitra* subgenus *Gyromitra*

1. Fruiting period vernal.. ***G. esculenta***
1'. Fruiting period autumnal..2
  2. Ascospores non-apiculate, narrowly ellipsoidal, 17-23 μm long........ ***G. infula***
  2'. Ascospores apiculate, subfusoidal, 21-30 μm long.................. ***G. ambigua***

Gyromitra ambigua (P. Karsten) Harmaja, 1969, Karstenia 9: 17.

≡*Helvella ambigua* P. Karsten, 1879, Meddelanden af Societas pro Fauna et Flora Fennica 5: 53.

=*Gyromitra infula* var. *apiculatispora* Raitviir, Eesti NSV Teaduste Akadeemia Toimetised 14 (Bioloogiline Seeria 3): 322. (*fide* Harmaja 1969b).
(additional synonyms see Harmaja 1969b).

Type material: Holotype H, examined.

Figs. 1a, 21, 29.

Apothecium: 3-46 mm diam., 2-25 mm high (up to 70 mm diam. fresh), irregularly lobed, often bilobate, margin flared when young, becoming appressed to stipe, usually fused to stipe and along apothecium, hymenium (fresh) red brown to dark red brown, often with violet tints, dark red brown to blackish red brown when dry, undulate-rugose or rarely smooth, excipular surface white to cream or light red brown, pubescent. **Stipe:** 3-58 x 1.5-21 mm, equal, enlarged gradually to base, or enlarged slightly at base and apex, pale pinkish cream or purple brown often with strong violaceous tints, pubescent, terete or fluted at base, solid, rarely hollow at base. **Asci:** 220-394 x 13.9-18.6 μm. **Paraphyses:** 5.4-8.8 (10) μm diam. at apex, clavate, gradually enlarged or abruptly swollen, yellow brown to red brown, dark red brown in mass, contents granular, apical cell 43-66 μm long. **Ascospores:** 21.4-30.0 x 7.7-11.2 μm, typically subfusoidal, sometimes ellipsoidal and fusoidal spores also present, smooth, finely rugose with SEM, biguttulate, very rarely with 1 or 3 guttules, distinctly or indistinctly apiculate, apiculi 1-2 μm long, broadly rounded.

Habitat: Solitary, gregarious, or scattered in soil or duff or on rotted wood under conifers. Associated trees: *Picea glauca, Pinus contorta, Pinus banksiana, Thuja plicata,* and *Abies lasiocarpa.* Associated shrubs: *Alnus crispa, Arctostaphylos uva-ursi, Viburnum edule*, and *Vaccinium myrtilloides*. Fruiting from July 23 in AK to February 7 in BC. November through February collections are known only from southern coastal regions.

Distribution: Widely distributed in boreal, montane and coastal forests from AK, YT, BC, AB, SK, MB, and WA. Reported from MT (Raitviir 1965, as *G. infula* v. *apiculatispora*). This species is newly reported for SK and MB. Also distributed in eastern North America (Huhtinen 1982; Weber 1988), Europe (Harmaja 1969b, 1976c) and Asia (Raitviir 1965, as *G. infula* v. *apiculatispora*). Map 3.

Notes: *Gyromitra ambigua* is closely related to *G. infula* (q.v.), the only other autumnal species in North America. The two share similar habitat and geographic regions. Macroscopically they are difficult to separate, although *G. ambigua* tends to be darker red brown with stronger violaceous tints, and is typically smaller. Although some authors suggest that fresh specimens of the two species cannot be distinguished macroscopically (e.g., Kempton and Wells 1973), the senior author is able to identify most collections of *G. ambigua* in the field. Spore size and apiculation are the most important and reliable differentiating features. Although spore size and degree of apiculation vary somewhat in other taxa, such as *G. esculenta* (q.v.), they are consistent and distinct in *G. ambigua* and *G. infula*.

Collections Examined: **CANADA: Yukon:** Watson Lake, Ziller 07 30 1962, DAOM 92258; Watson Lake, Abbott (SA 191, 198, 199) 08 19 & 20 1989, SA; Murphy Creek, Ginns, DAOM) Vancouver, Waugh 08 30 1956, DAOM 57615; Vancouver, Melburn 02 7 1957, DAOM 54645. **Alberta:** 145 km north of Fort McMurray, Danielson (RMD 1726) 09 1 1975, ALTA; Riley Lake, Jasper N.P., Abbott (SA 1055) 09 7 1995, SA; Strachan, southwest of Rocky Mountain House, Nordin 08 21 1956, CFB 3168; Lake Minnewanka, Banff N.P., Funk 10 2 1961, DAOM 92260. **Saskatchewan:** Prince Albert N.P., Zelmer (PA 554, 616) 08 9 1995, ALTA. **Manitoba:** Clear Lake, Bisby 09 23 1933, DAOM 206808. **Québec**: Chibougamau, Ammirati (JFA 7652), WTU; Dufesne River, Ammirati (JFA 7742) 04 3 1978, WTU. **USA: Alaska:** near Fairbanks, Kempton 08 23 1966, WK 859; WK 4778; Talkeetna junction, Kempton 08 15 1970, WK 4724, 4725, 4726, 4727; near Copper Centre, Kempton, WK 4886; near Palmer, Kempton 07 23 1970, WK 4536; Anchorage, Kempton 08 30 1967, 09 28 1971, WK 869, 5673; Hope road, Kempton 07 27 1968, WK 875, 878; Turnagain Pass, Kempton 09 30 1971, WK 5693; Beaver Lakes, Matanuska valley, Kempton 08 20 1970, Homer, Kempton 09 2 1967, WK 870, 872; Katmai National Monument, Kempton 09 4 1971, WK 5457. **Washington:** Seattle area, van de Bogart 11 15 1975. **FINLAND:** Karsten (PAK 3289) 07 30 1866, H (holotype). **Exsiccata**: Solheim, Mycoflora Saximontanensis, 302, Colorado, USA, Shope 09 9 1937, s.n. *Helvella infula*, WSP.

Gyromitra esculenta (Persoon : Fries) Fries, 1849, Summa Vegetabilium Scandinaviae 2: 346.

≡*Helvella esculenta* Persoon : Fries, 1823, Systema Mycologicum 2: 16.

≡*Elvela esculenta* Persoon, 1800, Commentarius Fungorum Bavariae indigenorum, 64.

=*Gyromitra bubacii* Velenovsky, 1922, Ceské houby p. 893, Praha. (holotype PRC, examined).

(additional synonyms see Harmaja 1979b; Weber 1988).

Type material: unknown (*fide* Harmaja 1979b).

Figs. 19, 30.

Apothecium: 5-90 mm diam., 5-55 mm high (up to 140 x 110 mm fresh), irregularly lobed, highly convoluted, margin reflexed, fused to the stipe in several locations, rarely free when young, hymenium (fresh) medium to dark red brown, sometimes orange brown or with paler red to orange brown regions, dark red brown to blackish red brown when dry, undulate-rugose to convoluted-wrinkled, excipular surface white to pale yellow brown or pale red brown, finely pubescent. **Stipe:** 5-90 x 3-30 mm (100 x 70 mm fresh), equal, enlarged at base, or tapered to base, cream, yellow brown, or red brown, typically with strong purple tints, pubescent, slightly to strongly fluted at base or along entire stipe, often terete when young, solid or with hollow chambers. **Asci:** 180-220 x 15-17 μm. **Paraphyses:** 2-9 (10) μm diam. apex, clavate, gradually enlarged or abruptly swollen, pale brown, brown in mass, contents granular, apical cell 39-77 μm long. **Ascospores:** (17) 19.1-28 x 10-13.1 (14) μm, ellipsoidal to subfusoidal, hyaline, spore deposit white to ochraceous, smooth, finely rugose with SEM, biguttulate, apiculus absent or apices slightly thickened to 1 μm.

Habitat: Solitary, gregarious, subcaespitose, or scattered on ground in soil, litter, or woody debris under conifers or in mixed woods. Occasionally on well rotted wood or burnt debris. Associated trees: *Picea glauca, Picea engelmannii, Picea mariana, Pinus contorta, Pinus banksiana, Pinus ponderosa, Pinus taxicola, Pinus monticola, Populus tremuloides, Populus balsamifera, Abies lasiocarpa, Abies grandis, Betula papyrifera, Pseudotsuga menziesii, Thuja plicata, Larix occidentalis, Tsuga sp., Arbutus menziesii* and *Arctostaphylos* sp. (manzanita). Associated shrubs: *Potentilla fruticosa, Shepherdia canadensis, Arctostaphylos uva-ursi, Juniperus horizontalis, Viburnum edule, Vaccinium myrtilloides*, and *Symphoricarpos* sp. Fruiting period from February 8 on Vancouver Island, BC to July 5 in ID, with the majority of collections in May and June. February through April collections are known only from southern coastal regions.

Distribution: Widely distributed throughout boreal, montane, and coastal forests from AK, YT, BC, AB, MB, WA, ID, OR, and WY. Also distributed in eastern North America (Groves and Hoare 1953; Weber 1988), Europe (Harmaja 1979b), and Asia (Imai 1954; Korf and Zhuang 1991). Map 1.

Notes: *Gyromitra esculenta* is separated from other species in the subgenus by the large convoluted apothecium and vernal fruiting pattern. The morphologically similar *G. infula* (q.v.) and *G. ambigua* (q.v.) are also separated by spore size and apiculation, ascocarp coloration, and degree of apothecial convolution.

Harmaja (1979b) recognized three distinct ascospore morphologies differing in size, shape, apiculation, and guttulation. Although these features vary considerably among collections, there seems no correlation between these features and other characteristics separating taxa. Furthermore, spore size and shape vary considerably within individual ascocarps. The holotype of *Gyromitra bubacii* represents an extreme with large ascospores, which vary in size from 21.7 to 35.3 μm long (Moravec 1986), but the guttules are smaller than described for Harmaja's (1979b) Type III which also has large ascospores. Moravec (1986) considers it a variety of *G. esculenta*. Due to the extreme variability seen in *G. esculenta* and lack of correlated characteristics, *G. bubacii* is placed in synonymy.

Collections Examined: **CANADA: Yukon:** Annie's Lake, Schalkwyk 07 4 1981, DAOM 183550, 183551, 183552. **British Columbia:** Burns Lake, Arnold 06 18 1965, DAOM 113992; Revelstoke, Macoun 05 9 1890, DAOM 44704; Mount Revelstoke N.P., Schumacker 05 23 1986, ALTA; Spuzzum Creek near Yale, Wood 05 31 1972, DAOM 143565; Procter, Linton 05 15 1978, UVIC; Lake Cowichan, Vancouver Island, Paden (JWP 1343, 1344, 1347) 05 22 1986, UVIC; Francis Park, Victoria, Vancouver Island, Egger 04 26 & 28 1985, DAOM 199519, 199526; Saltspring Island, Linton 04 20 1974, UVIC; Chilliwack River, Stirling 05 8 1982, UBC F907; Manning P.P., Egger 06 9 1985, DAOM 199550, 199552, 199559; Champion Lakes near Trail, Danielson (RMD 709) 06 3 1973, ALTA. **Alberta:** Richardson Fire Tower 150 km north of Fort McMurray, Danielson (RMD 1897) 04 27 1976, ALTA; east of Slave Lake, Hambleton & Richardson 05 22 1995, ALTA; Cross Lake, Ansley and Hichling 05 12 1977, ALTA 7488; Carson-Pegasus P.P., Abbott (SA 761) 05 15 1993, SA; Whitecourt, Stewart 06 5 1963, ALTA 685; Astotin Natural Area near Bruderheim, Abbott (SA 315) 05 13 1990, SA; Maligne Lake, Jasper N.P., 06 30 1996, SA 1160; south of Edson, Vitt 06 1 1974, ALTA 7182; near Robb, 05 23 1994, SA 938; Wabamun Lake, Seymour 05 26 1963, ALTA 684; Devonian Botanic Garden near Devon, Abbott (SA 358, 939, 1061, 1144) 06 9 1990, 05 30 1994, 05 28 1995, 05 26 1996, SA, K; Devonian Botanic Garden near Devon, Currah 05 18 1976, 06 30 1979, 05 15 1981, ALTA 7237, 7956, SA 13; near Devon, Osis and Gibson (SA 312) 05 12 1990, SA; north of Devon, Osis (SA 690) 06 13 1992, SA; North Saskatchewan River valley near Devon, Abbott (SA 645) 05 15 1992, UAMH 7350 (living culture); near Breton, Osis (SA 20, 356) 05 14 1989, 05 27 1990, SA; Poplar Creek Natural Area near Breton, Osis (SA 666) 05 24 1992, SA; Moose Hill, Poplar Creek Natural Area, van der Schoot 05 15 1994, SA 937; Strachan, southwest of Rocky Mountain House, Bourchier 05 27 1960, CFB 4040, 4041, 4044, 4045, 4046, 4047; Strachan, southwest of Rocky Mountain House, Bourchier 06 9 1961, CFB 4458; Cirque Lake, Banff N.P., Beil

06 24 1964, ALTA 671; Forestry Trunk Road, Danielson (RMD 2722) 06 18 1978, ALTA; Sheep River, Danielson (RMD 1383, 1520, 1925) 06 9 1974, 06 1 1975, 05 23 1976, ALTA; Blackiston Falls Trail, Waterton Lakes N.P., Abbott (SA 341) 05 29 1990, SA. **Manitoba:** Victoria Beach, Lake Winnipeg, Bisby 06 2 1928, 05 25 1931, DAOM 151579, 206571. **Ontario:** Lake Simcoe near Gilford, Ammirati (JFA 8367) 05 17 1979, WTU; Nancy Lake west of King, Bell 05 21 1940, TRTC 18475; Black Sturgeon Lake, Hale 06 8 1976, WTU (JFA 7360); near Carlsbad Springs, Horner 05 23 1954, K. **Québec:** Masham, Darker & Shoemaker 05 31 1963, CFB WINFM 10931, DAOM 93064. **USA: Alaska:** Willow, Burner 06 18 1971, WK 5034; Eklutna Lake north of Anchorage, Kempton 06 22 1966, WK 1059; Bird Creek, Chugach National Forest, Cooke 06 21 1970, WSP 61117; Anchorage, Kempton 06 10 1971, WK 4866; Beaver Lakes, Matanuska valley, Kempton 05 28 1988 & 1989, WK 6551, 6616; Trail River near Seward, Kempton 06 19 & 21 & 29 1971, WK 5021, 5022, 5023; Russian River, Kenai Peninsula, Kempton 07 4 1971, WK 5040. **Washington:** Birch Bay near Blaine, Isaacs (Is 1588) 05 2 1962, WTU; Glacier, Paden (JWP 699, 700) 05 5 1969, UVIC; Colville, Conner 06 1 1948, WSP CS17389; Ford, Smith 05 2 1928, WSP 32173; Pend Oreille Co., Slipp 06 17 1942, WSP 49791; Mutiny Bay, Island Co., van de Bogart (FVB 3354) 03 2 1975, WTU; Seattle, Fitzpatrick (Stz 6652) 04 9 1952, WTU; Seattle, Parker (YNS 49) 03 24 1892, WTU; Watermain Woods, Redmond, van de Bogart (FVB 3599, 3404) 04 25 & 26 1975, WTU; east of Skykomish, Cohen (Stz 6711) 05 19 1952, WTU; east of Stevens Pass, Brough (70) 05 25 1957, WTU; below Goose Creek along Chiwawa River, Ammirati (JFA 9394) 05 23 1987, WTU; Big Tree Park, Snoqualmie Pass, Snyder (100) 04 15 1934, WTU; Kachess Lake turnoff near Snoqualmie Pass, Isaacs (Is 1679) 05 12 1962, WTU; American River, Beeman (Stz 1219) 05 31 1942, WTU; Clearwater R.S., Garfield Co., Goheen 06 4 1948, WSP CS25651; Amboy, Smith 04 5 1954, WSP 41138; Bingen, Suksdorf 04 7 1901, WSP 27278; Lee Forest near Maltby, Cohen (Stz 6687, 6704) 05 3 & 11 1952, WTU; Birmingham, Zeller (265) 04 6 1914, WTU; unknown, Snyder (5), Vogel (Stz 15446) 05 10 1969, Isaacs (Is 555) 03 31 1957, (Stz 10669) 04 1958, #10 6666, 6213, WTU. **Idaho:** Priest River Experimental Forest, Slipp 06 2 1942, WSP 49881; natural area of Priest River Experimental Forest, Miller 07 5 1964, WSP 54436; east of Viola, Shaw 05 21 1948, WSP CS17376, CS17388; north of Moscow, SMD 05 30 1954, WSP 41127; Thatuna Ridge, Latah Co., Cooke 05 1948, WSP AS30089, DAOM 26787; Upper Jerome Creek, Latah Co., Tylutki 05 10 1965, WSP 56315; Payette Lake, Ammirati (JFA 9276) 06 13 1986, WTU; Payette River south of McCall, Miller 06 4 1964, WSP 54406. **Oregon:** Sauvies Island near Portland, Hinds 03 14 1987, WTU; near MacDougall Camp, Blue Mountains, Umatilla Co., Cooke 06 16 & 17 & 18 1948, WSP 19851, 19848; near Spout Springs in Umatilla National Forest, Blue Mountains, Union Co., Cooke 06 17 1948, WSP 19850; south of Gold Hill, Isaacs (Is 1387), WTU; Medford, (Is 1349) 03 22 1961, WTU; Mt. Ashland near Ashland, (Is 1776) 06 10 1962, WTU. **Wyoming**: Lower Falls on Uncle Tom's Trail, Yellowstone N.P., Brough (80) 06 29 1957, WTU. **NORWAY:** Hedmark, Ringsaker, Muremyra, Minter 06 1 1988, IMI 328178. **SWEDEN:** near Storvreta, Upland, Lundell 05 1935, K. **UNITED KINGDOM:** Colchester, Essex, Hartley 04 10 1989, IMI 332384. **BELGIUM:** Meerdaal, Heinemann 04 19 1964, K. **CZECHOSLOVAKIA:** Dobris 05 15 1921, PRC 216 (holotype of *G. bubacii*). **Exsiccata**: Vancouver Island Fungi, 254, Sidney, BC, Canada, Macoun 02 8 1915, s.n. *Helvella lacunosa*, UBC F3270; Vancouver Island Fungi, 344, Vancouver Island, BC, Canada, Macoun 02 25 1915, s.n. *Gyromitra esculenta*, UBC F3237; Cooke, Mycobiota of North America, 319, Blue Mountains, Umatilla Co., OR, USA, Cooke 06 16 1948, s.n. *Helvella infula*, WSP 23656.

Gyromitra infula (Schaeffer : Fries) Quélet, 1886, Enchiridion Fungorum p. 272.

≡*Helvella infula* Schaeffer: Fries, 1823, Systema Mycologicum 2: 17.

≡*Helvella infula* Schaeffer, 1774, Fungorum qui in Bavaria et Palatinatu circa Ratisbonam nascuntur icones 4: ind. 105.

=*Helvella friesiana* Cooke, 1875, Mycographia, seu icones fungorum 1: 195. (lectotype, selected Harmaja 1969b, K, examined).

?=*Gyromitra columbiana* Harmaja, 1986, Karstenia 26:41. (see notes) (additional synonyms see Harmaja 1969b).

Type Material: Neotype K (designated Harmaja 1969b, =lectotype of *H. friesiana*), examined.

Fig. 1b.

Apothecium: 17-80 mm diam., 25-70 mm high (up to 130 x 95 mm fresh), saddle-shaped to irregularly lobed, often bilobate, margin typically fused to stipe and along apothecial margin, hymenium (fresh) yellow brown to orange brown, sometimes dark red brown in age, dark brown to red brown or blackish brown when dry, typically undulate-rugose, but sometimes wrinkled-convoluted or nearly smooth, excipular surface white to pale brown, pubescent. **Stipe:** 9-90 x 5-30 mm (up to 110 x 60 mm fresh), pallid pinkish cream to greyish purple brown, equal or enlarged at base, terete or often fluted at base, pubescent. **Asci:** 250-300 x 12-17 µm. **Paraphyses:** 7-10 µm diam. apex, clavate, gradually enlarged or abruptly swollen at apex, brown, contents granular. **Ascospores:** 17-23 x (7) 8-10 (11) µm, narrowly ellipsoidal, hyaline, spore deposit white to pale cream, smooth, finely rugose with SEM, biguttulate, very rarely with 1 or 3 guttules, non-apiculate.

Habitat: Solitary, gregarious, subcaespitose, or scattered on ground or more often on rotted coniferous or deciduous wood in coniferous or mixed woods, rarely in deciduous woods. Associated trees: *Picea glauca, Picea mariana, Picea sitchensis, Picea engelmannii, Pinus contorta, Pinus banksiana, Pinus monticola, Abies balsamea, Abies grandis, Pseudotsuga menziesii, Tsuga heterophylla, Larix occidentalis, Thuja plicata, Populus balsamifera, Populus tremuloides, Acer macrophyllum, Alnus* sp., and *Betula papyrifera*. Associated shrubs: *Alnus crispa*, *Salix* sp., and *Rosa* sp. Fruiting from July 15 to February 17 in BC, with the majority of collections in August, September, and October.

Distribution: Widely distributed throughout boreal, montane and coastal forests from AK, NWT, BC, AB, SK, MB, WA, ID, MT, and WY. Also reported from OR (Larsen and Denison 1978), eastern North America (Groves and Hoare 1953; Weber 1988), South America (Dennis 1970), Europe (Harmaja 1969b), and Asia (Korf and Zhuang 1991). Map 2.

Notes: Relatively small spore size, narrowly ellipsoidal shape, and lack of distinct apiculation are characteristic for *G. infula.* This species is closest to *G. ambigua* (q.v.). Some early authors (e.g., Seaver 1928) united *G. infula* with *G. esculenta* (q.v.), but the species are easily distinguished by fruiting time, in addition to macroscopic and anatomical differences. Kanouse (1946) states that one of the features separating *G. infula* from *G. esculenta* is the consistent association of *G. infula* with deciduous trees. This is questioned, but accepted by Groves and Hoare (1953). Collections of *G. infula* in the northwest of North America are much more frequently associated with coniferous wood. *G. infula* and *G. esculenta* are both associated with coniferous and deciduous trees and are widely distributed, often at the same localities. The two species are best distinguished by fruiting time, ascocarp coloration and structure, and ascospore morphology.

Harmaja (1986) described *G. columbiana* from British Columbia, and separated it from *G. infula* based on the densely folded hymenium and large clavate paraphyses, and from *G. esculenta* based primarily on smaller ascospores. He also notes that it was not possible to determine vernal versus autumnal fruiting pattern. Although we have not examined the type, the description seems consistent with *G. infula*. Several collections were examined with highly convoluted apothecia which were otherwise typical of *G. infula*, and our observations of paraphyses are not substantially different from those described for *G. columbiana*. Rahm (1970) describes *G. infula* forma *gyrosa* Benedix, which is highly convoluted and similar in habit to *G. esculenta.* Also, given our familiarity with the Shuswap region of British Columbia, we suggest that the collection made on July 30 represents an autumnal fruiting pattern, even given the elevation of 1500 metres.

Collections Examined: **CANADA: Northwest Territories:** Pine Point, Dube 09 1983, DAOM 188769. **British Columbia:** Muncho Lake P.P., Abbott (SA 208) 08 21 1989, SA; Procter, Linton 09 19 1978, UVIC; Cathedral Grove near Port Alberni, Vancouver Island, Smyth 10 10 1977, UVIC; Sidney, Vancouver Island, 12 16 1913, DAOM 44705; Victoria, Vancouver Island, Newcombe, K; James Island near Central Saanich, Simmonds 02 17 1977, UVIC; University of BC campus, Vancouver, Kroeger 10 29 1986, UBC F12833; Vancouver, Waugh 07 15 1951, 10 16 1960, DAOM 26944, 71910; Similkameen River, Manning P.P., Bandoni 07 16 1959, UBC F3271; near Yahk, 10 7 1993, SA 991. **Alberta:** Richardson Fire Tower 150 km north of Fort McMurray, Danielson (RMD 1703) 09 1 1975, ALTA; Fawcett Lake, Abbott 09 3 1988, ALTA 8451; Carson

Lake, Currah 08 26 1977, ALTA 7538; Sandy Lake, Schalkwyk 08 16 1980, DAOM 180173; William A. Switzer P.P., Abbott (SA 272, 274, 276, 277) 08 27 1989, SA; William A. Switzer P.P., Osis (SA 395, 396) 09 2 1990, UAMH 7349 (living culture), SA; Valley of the Five Lakes, Jasper N.P., 08 18 95, SA 1089; Fryatt valley, Jasper N.P., Richardson (SA 299) 09 22 1989, SA; near Onoway, Osis (SA 879) 08 8 1993, SA; east of Spruce Grove, Abbott (SA 897) 08 22 1993, SA; Spruce Grove area, Kennedy 08 20 1980, ALTA 8060; Wagner Natural Area, Abbott (SA 1104) 08 19 1995, SA; University of Alberta Forest Reserve, Edmonton, Traquair 09 14 1970, ALTA 4140; Whitemud Creek, Edmonton, Abbott 09 13 1987, ALTA 8450; Devonian Botanic Garden near Devon, Abbott (SA 1136) 09 9 1995, K; near Breton, Abbott (SA 385) 08 9 1990, SA; Fish Lake near Nordegg, Abbott (SA 283) 08 31 1989, SA; Crimson Lake, Kennedy 08 31 1976, ALTA 7239; Forestry Trunk Road, Forest Reserve, west of Calgary, Danielson (RMD 2818) 09 3 1978, ALTA; Yamnuska near Seebe, Danielson (RMD 1774, 1777) 09 9 1975, ALTA; Brown Lowery Natural Area, Danielson (RMD 451, 499, 1086, 1088, 1089, 1187) 08 27 & 09 2 1972, 08 26 & 09 3 1973, ALTA; Fish Creek P.P., Calgary, Danielson (RMD 996, 1062) 08 9 & 21 1973, ALTA; Marmot Creek, Kananaskis, Danielson (RMD 2316) 09 2 1976, ALTA; Laggan, Hone 08 23 1903, TRTC. **Saskatchewan**: Prince Albert N.P., Zelmer (PA 352, 611, 914) 1994 & 1995, ALTA; Candle Lake, Zalasky 09 1 1955, CFB WINFM 1339. **Manitoba:** Steep Rock Lake, Lawrence 09 18 1969, CFB WINFM 12354; Victoria Beach, Lake Winnipeg, Bisby 09 12 1926, DAOM 206805, 206806; Minaki, Bisby 09 27 1925, DAOM 206807; Singush Lake, Parker 09 21 1975, DAOM 187879; Duck Mountain, Parker 08 7 1977, DAOM 165377. **Ontario:** Thunder Bay District, Lahie 08 11 1978, TRTC. **USA: Alaska:** Fairbanks, Kempton 08 7 & 8 1970, WK 4639, 4666; Talkeetna junction, Suisitna valley, Kempton 08 15 1966, 08 16 1970, 08 29 1971, WK 856, 4723, 4728, 5239; Liberty Falls Creek, Copper River valley, Kempton 09 5 1970, WK 4588; Eklutna Lake north of Anchorage, Kempton 08 24 & 09 21 1971, WK 5199, 5215, 5614; Anchorage, Kempton 08 10 & 09 9 & 26 & 28 1971, WK 7133, 5505, 5658, 5672; Girdwood, Kempton 09 23 1969, WK 4310; Kenai Lake, Kenai Peninsula, Kempton 09 6 1967, WK 866; Haines, Kempton 09 9 1967, 09 20 & 21 1970, WK 873, 4963, 4971. **Washington:** Whidbey island, Meeure (Stz 17552) 10 31 1972, WTU; Blewett Pass, Cascade Mountains, Grant 08 1929, MU F14163; near Gifford, van de Bogart (FVB 834) 10 23 1971, WTU; Hermit Mountain trail, Puget Sound, Fink 07 1906, MU F1559; Seattle, Stuntz 11 1 1934, WTU; Seattle, Zeller (54, 205) 1911 & 03 1914, WTU; Seattle, Murril 10 20 & 11 1 1911, NY; Watermain Woods, Redmond, Williams (JWL 1683) 10 13 1973, WTU; confluence of north fork of Rogue and National Creek, Douglas Co., Isaacs (Is 198) 08 27 1957, WTU; Burping Brook, Mount Spokane, Simms 10 5 1968, WSP 58171; east of McCleary, van de Bogart (FVB 669) 11 3 1970, WTU; Silver Springs area, Chinook Pass, Isaacs (Is 1272) 10 1 1960, WTU; Tahoma Creek, Mount Rainier N.P., van de Bogart (FVB 1489) 10 22 1971, WTU; Tahoma Creek, Mount Rainier N.P., Brough 11 2 1963, UBC F3239; White River near Mount Rainier N.P., Isaacs (Is 673) 10 5 1958, WTU; Iron Butte, Cispus area near Randle, van de Bogart (FVB 1420) 10 21 1972, WTU; Bingen Mountain, Klickitat Co., Dietz 11 23 1901, WSP 27475; Teanaway, Woo (Stz 16689) 07 4 1971, WTU; south of Brown's Lake, van de Bogart (FVB 988) 11 13 1971, WTU; Lake Hannah, Stuntz (Stz 19958) 09 27 1976, WTU; road 1102/1102c junction, van de Bogart (FVB 938) 10 24 1971, WTU; road 1102 rock pit site, van de Bogart (FVB 828) 10 24 1971, WTU; Min. Park road, van de Bogart (FVB 2311) 10 21 1973, WTU; Moclips road, Stuntz (Stz 16859) 10 17 1971, WTU; unknown, Stuntz (Stz 13774, 17512) 10 29 1966, 10 22 1972, Williams (JWL 67), WTU. **Idaho:** Hunt Creek Road, Bonner/Boundary Co., Slipp 10 3 1940, WSP 49762; near Benton Spring, Priest River Experimental Forest, Bonner Co., Hayes 07 3 1941, WSP 49797; Coeur d'Alene, Rust (1014) 10 1918, WTU; Bovill, Rhoads 09 29 1920, UBC F3238; Dry Creek between Troy and Deary, Cooke 05 1948, WSP 30088; west end of Thatuna Ridge, Latah Co., Cooke 11 28 1947, WSP 24509; Laird Park, Latah Co., LES 10 28 1976, WSP 63256; Fall Creek at French Creek Grade, Idaho Co., Miller 09 4, 7 1964, WSP 53882, 53834; Upper Payette Lake, Miller 08 29 1964, WSP 54573; Snowslide Lake, Valley Co., Miller 08 18 1964, WSP 54557; Sater Meadows, Valley Co., Miller 08 6 1964, WSP 54187; Teels Creek road, van de Bogart (FVB 3732) 09 9 1976, WTU; Idaho, Slipp 09 16 1944, WSP 50858. **Montana:** Red Meadow Road, Flathead Co., Young 07 24 1967, WSP 57826; Echo Lake, Flathead National Forest, Cummins 07 23 1928, MICH. **Wyoming:** Grassy Lake, Targhee National Forest, Ammirati (JFA 9420) 08 7 1987, WTU. **California:** Lassen Volcanic N.P., Cooke 10 8 1976, WSP 63394. **New York:** Lake Placid, Adirondacks, Murrill 10 3-14 1912, NY 565. **COSTA RICA**: Cuericí, Talamanaca Ridge, Gómez 09 13 1969, K. **SWEDEN:** Uppsala, Fries, Herbarium Berkeley (lectotype of *H. friesiana* and neotype of *G. infula*); Gottsunda skog near Uppsala, Lundell 10 3 1935, K. **CZECHOSLOVAKIA:** Delroi Virgin Forest, Slovakia, 09 24 1964, K. **Exsiccata**: Vancouver Island Fungi, 33, Sidney, BC, Canada, Macoun 1912, s.n. *Helvella infula*, UBC F3269; Vancouver Island Fungi, 23, Sidney, BC, Canada, Macoun 1912, s.n. *Helvella crispa*, UBC F3247.

Extralimital Species

Gyromitra sichuanensis Korf and W.Y. Zhuang, 1985, Mycotaxon 22: 490.

Type Material: Holotype and paratype HKAS; isotype and isoparatype CUP, examined.

Distribution: Known only from China (Korf and Zhuang 1985; Cao 1988).

Notes: This species is closely related to *G. infula* (q.v.), but differs in its more coarsely ornamented ascospores.

Collections Examined: **CHINA:** Wu Geng mountains, Sichuan Province, Xing-jiang 08 12 1981, CUP CH2522 (isotype); Xiangchen Co., Sichuan Province, Xing-jiang 08 12 1981, CUP CH2523 (isoparatype).

Gyromitra tasmanica (Berkeley) Berkeley & Cooke, 1878, in Cooke, Mycographia, seu icones fungorum 1: 193, t. 90, f. 331.

≡*Helvella tasmanica* Berkeley

Type Material: Holotype K, examined.

Distribution: Tasmania and New Zealand (Cooke 1878; Raitviir 1965) and reported from Europe (Torre 1976; Calonge and Torre 1977).

Notes: This species is closely related to *G. esculenta* (q.v.), but is tentatively accepted as a distinct southern hemisphere species. It differs in its smaller stature and typically free apothecial margin. European specimens were not seen. Several specimens with gross morphology similar to *G. tasmanica* were found among the collections from northwest North America, but are included in the variable species *G. esculenta.*

Collections Examined: **AUSTRALIA:** Tasmania, Archer, Herbarium Berkeley 1879, K (holotype). **NEW ZEALAND**: Ringaringa, Stewart Island, Traill 08 28 1959, K; Wellington, Travers, Herbarium Cooke 1885, K; New Zealand, Colenso, K.

Gyromitra* Subgenus *Melaleucoides S.P. Abbott, *subgen. nov.*

Apothecia sessilia vel substipitata, cupulata, hymenium griseo-brunneum; ascosporae elipsoideae, biguttulatae, nonapiculatae, verrucosae.

Type species: *Gyromitra melaleucoides* (Seaver) Pfister, 1980, Mycologia 72: 615.

Ascocarp: subsessile to stipitate, cupulate, discoid, or reflexed; hymenium dark grey brown to brown, undulate-rugose; excipular surface glabrous to finely pubescent. **Ascospores:** ellipsoidal to broadly ellipsoidal, biguttulate, appearing distinctly roughened (LM), with SEM surface ornamentation composed of distinct isolated broadly rounded warts.

Notes: This subgenus is described on the basis of ascospore ornamentation which is distinctively verrucose by LM, consisting of numerous isolated rounded warts (Fig. 40) by SEM. The warts are uniform in size and distribution. Ascospores are nonapiculate and biguttulate, and a few contain de Bary bubbles at maturity.

Gyromitra melaleucoides (Seaver) Pfister, 1980, Mycologia 72: 615.

≡*Peziza melaleucoides* Seaver, 1928, The North American Cup-Fungi (Operculates), p. 225.

=*Paxina recurvum* Snyder, 1936, Mycologia 28: 487. (paratype and authentic material NY, examined).

≡*Gyromitra recurva* (Snyder) Harmaja, 1978, Karstenia 18: 57.

Type material: Holotype NY, examined; authentic material NY, examined.

Fig. 40.

Apothecium: 9-68 mm diam., 9-50 mm high (up to 110 mm diam. fresh), irregularly discoid, cupulate, or lobed, margin typically reflexed, free from stipe, hymenium dark grey brown, brown or dark red brown when dried, smooth to undulate-rugose, excipulum cream to pale yellow brown, glabrous to finely pubescent. **Stipe:** 15-50 x 3-26 mm, distinctly flaring at apex, below equal or enlarged at base, cream to pale yellow brown, glabrous to finely pubescent, infolded/fluted, internally with hollow chambers. **Asci:** 205-235 x 11.0-14.6 µm. **Paraphyses:** 5.4-9.0 µm diam. at apex, terminal cell 53-105 µm long, clavate, enlarged gradually to apex, pale yellow brown to brown individually, brown in mass. **Ascospores:** 11.6-14.4 x 8.0-9.4 µm, ellipsoidal to broadly ellipsoidal, especially when immature, hyaline, rough, warted, ornamentation of isolated rounded warts with SEM, non-apiculate, biguttulate or infrequently uniguttulate, guttules spherical, de Bary bubbles present in a small proportion of mature spores.

Habitat: Solitary, gregarious, subcaespitose, or scattered on soil, litter, or rotted wood in coniferous or mixed forests. Associated trees: *Picea* sp., *Pinus ponderosa, Abies grandis, Tsuga* sp., and *Arbutus menziesii*. Fruiting from April 11 in BC to July 22 in ID. May and June collections are most common.

Distribution: Endemic to northwestern North America in montane sites in the coastal and Rocky Mountains from AK, BC, AB, WA, and ID. Also reported from OR and MT as *Peziza melaleucoides* and *Paxina recurvum* respectively by Larsen and Denison (1978). This species is newly reported for AK and AB. Distribution extends south of the study area to Colorado (Pfister 1980). Map 6.

Notes: This species is morphologically distinct from all others in the genus, and is placed in its own subgenus on the basis of ascospores which are the smallest in the genus and relatively broader than other species. In addition, the spores bear distinct, isolated knob-like warts. The predominantly grey ascocarp is also unique. The biguttulate, ellipsoidal spores are more similar to the subgenus *Gyromitra* than subgenera *Discina* and *Caroliniana,* but the stipe of *G. melaleucoides* is less distinct than typical for species in the subgenus *Gyromitra*. *Gyromitra melaleuca* (q.v.) is similar to this species, but appears intermediate between *G. melaleucoides* and members of subgenus *Discina* (e.g., *G. olympiana*). Pfister (1980) regarded *G. melaleucoides* as morphologically intermediate between stipitate *Gyromitra* (*sensu stricto*) species and typically cupulate species of *Discina*, and therefore accepted the genus *Gyromitra* in a broad sense to encompass both genera.

Discrepancies between the type specimens of *P. recurvum* at NY and the protologue (Snyder 1936) are discussed by Harmaja (1979b). No holotype specimen was located in WTU or other herbaria in this study.

Collections Examined: CANADA: British Columbia: Saltspring Island, Linton 04 11 & 20 & 21, 1974, UVIC; Manning P.P., Egger 06 9 1985, DAOM 199548. **Alberta:** Whirlpool River valley, Jasper N.P., Baranyay 07 5 1960, CFB 4297; Watridge Lake area of Kananaskis country, Danielson (RMD 3816) 06 9 1991, ALTA. **USA: Alaska:** Hope road, Kempton 06 25 1967, 07 5 1970, WK 1137, 4455; Turnagain Pass near Seward, Kempton 07 21 1970, WK 4512. **Washington:** Stampede Pass, Paden (JWP 535) 06 3 1967, UVIC; Watermain woods, Redmond, Bolen (SLB 492) 04 21 1978, WTU; east of Skykomish, Cohen (Stz 6715) 05 19 1952, WTU; Snoqualmie Pass area, Stuntz (Stz 13313) spring 1965, WTU; Lake Keechelus, Snyder 04 15 & 05 5 1934, NY (type of *Gyromitra recurva*); east end of Lake Keechelus, (Is 1732) 05 27 1962, WTU; west of Lake Easton, Stuntz (Stz 1230) 06 21 1942, WTU; Cle Elum, (Stz 12348) 05 21 1961, WTU; Cle Elum, (Stz 20342) 05 13 1978, WTU; Iron Butte Road, van de Bogart (FVB 2875) 07 13 1974, WTU; Road West Mt., Ammirati (JFA 9271) 06 12 1986, WTU. **Idaho:** Priest River Experimental Forest, Miller 07 4 1964, WSP 54399; Snick's Bog, Paden (JWP 72) 06 6 1964, WSP 56310; North-South Ski Bowl, Benewah Co., Miller 06 1 1964, WSP 56300; Brundage Mountain, Paden (JWP 214) & Tylutki 07 22 1964, WSP 56295. **Colorado:** Tolland, Overholts (1792) 06 19 1914, NY (holotype); Giants Ladder, Tolland, Overholts (1809) 06 21 1914, NY; Jennie Creek, Tolland, Overholts (1874) 07 7 1914, NY.

Extralimital Species

Gyromitra melaleuca (Bresadola) Donadini, 1975, Bulletin de la Société Linnéenne de Provence 28: 74.

≡*Discina melaleuca* Bresadola, 1898, Fungi Tridentini novi, vel nondum delineati 2: 74.

≡*Peziza melaleuca* (Bresadola) Seaver, 1928, The North American Cup-Fungi (Operculates), p. 225.

Type Material: Holotype S.

Distribution: Known only from Europe (Donadini 1975, 1986; Benedix 1969; Ryman 1979). The North American reports by Seaver (1928, 1942) from Colorado and Washington are unconfirmed and may represent *G. melaleucoides*.

Notes: This species is tentatively placed in the subgenus *Melaleucoides* on the basis of morphological similarity and non-apiculate ascospores. Spores are often biguttulate, although the guttules are often different sizes and asymmetrical in the spore. Spores are warted to coarsely rugose, although material examined was of poor quality. Ascospores of *G. melaleuca* are larger than *G. melaleucoides* (q.v.). *Gyromitra melaleuca* may represent a taxonomic link between subgenera *Melaleucoides* and *Discina*.

Collections Examined: **FRANCE:** Sus le Croix Haute, Haute Alps, Allemant 05 20 1967, K; Colmars Basses Alpes, Riousset 05 25 1969, K. **GERMANY:** Neustadt, Weinstr., Thate 02-03 1975, K.

Pseudorhizina Jacevskij, 1913, Opredelitel gribov 1: 1913.

=*Helvellella* S. Imai, 1932, The Botanical Magazine (Tokyo) 46: 174.

=*Ochromitra* Velenovsky, 1934, Monographia Discomycetum Bohemiae p. 391.

=*Gyromitrodes* Vassilkov, 1942, Sovetskaya Botanika 6: 50.

Type Species: *Pseudorhizina sphaerospora* (Peck) Pouzar, 1961, Ceská Mykologie 15: 42.

Macroscopic Features: ascocarps epigeous, distinctly stipitate; apothecia irregularly convex, saddle-shaped, or irregularly lobed, margin reflexed; hymenium medium brown or grey brown to blackish brown; stipe deeply ribbed with ribs extending onto excipular surface, cream, often with vinaceous tints at base; flesh thin (1-2 mm), pliant to brittle. **Microscopic Features:** asci cylindrical, tapered to base, hyaline; paraphyses clavate; ascospores globose to ellipsoidal, appearing smooth with light microscope, with SEM very finely rugose to nearly smooth, non-apiculate, with one or two oil guttules, de Bary bubbles present at maturity, tetranucleate, cyanophilic perispore-periplasm complex absent at maturity, excipulum of *textura intricata* throughout, hyphae of excipulum thick-walled (0.7-2.0 µm diam., Harmaja 1974b).

Key to species of *Pseudorhizina*

1. Ascospores globose..***P. sphaerospora***
1'. Ascospores ellipsoidal..***P. californica***

Pseudorhizina californica (W. Phillips) Harmaja, 1973, Karstenia 13: 56.

≡*Helvella californica* W. Phillips, 1880, Transactions of the Linnean Society II Botany 1: 423.

≡*Gyromitra californica* (W. Phillips) Raitviir, 1965, Eesti NSV Teaduste Akadeemia Toimetised 14 (Bioloogiline Seeria 3): 320.

=*Elvela umbracauliformis* Seaver, 1928, The North American Cup-Fungi (operculates) p. 251. (*fide* Seaver 1942).

Type Material: Holotype K, examined.

Fig. 13.

Apothecium: 23-135 mm diam., 13-80 mm high, irregularly convex to lobed, margin reflexed, free from stipe, hymenium medium to dark brown (fresh and dried), nearly smooth to undulate rugose, excipular surface cream to pale yellow brown, pubescent, strongly ribbed, ribs sharp-edged, often reaching marginal region, continuous with those of the stipe. **Stipe:** 25-80 x 8-60 mm, tapering to base, flaring and merging with apothecium at apex, pale yellow brown, often with wine red tints near base, pubescent, deeply ribbed, ribs sharp-edged, widely spaced, internally sulcate and solid or with few chambers. **Asci:** 160-200 x 10-12 µm. **Paraphyses:** 6-8 µm diam. at apex, clavate, brown in mass. **Ascospores:** (14) 16.1-20.3 x (7.5) 8.4-10.7 µm, ellipsoidal, hyaline, smooth, with SEM very finely rugose, non-apiculate, biguttulate.

Habitat: Solitary to gregarious on soil, duff, or woody debris, rarely on rotted logs, in coniferous woods. Associated trees: *Tsuga heterophylla, Thuja plicata, Pseudotsuga menziesii, Picea engelmannii,* and *Pinus* sp. Fruiting from April 24 in BC to August 6 in ID and interior BC, June and July collections are common.

Distribution: Common west of the continental divide in montane and coastal forests from BC, WA, ID, and OR. Known distribution is extended north to the Queen Charlotte Islands, BC. This species is endemic to western North America, reported from MT (Raitviir 1965) and extending south to northern California, Colorado, and Nevada (Larsen and Denison 1978). Map 8.

Notes: This species is closely related to *P. sphaerospora*. The ellipsoidal, biguttulate, non-apiculate ascospores are similar to *Gyromitra* species in the subgenera *Gyromitra* and *Melaleucoides*. The finely rugose spore surface by SEM is also similar to species in *Gyromitra* subgenus *Gyromitra,* but is even less pronounced in *Pseudorhizina californica*. The holotype (K) matches the above description in all details.

Collections Examined: CANADA: British Columbia: near Masset, Graham Island, Queen Charlotte Islands, Egger (167) 06 9 1979, DAOM 172567; Mosquito Lake, Moresby Island, Queen Charlotte Islands, Ziller 07 2 1952, DAOM 56711; Mount Robson P.P., Wilson 07 29 1971, ALTA 4553; trail to Great Glacier, Glacier N.P., Shoemaker 08 1 1963, DAOM 109931; Mount Abbott near Marian Lake, Glacier N.P., Shoemaker 08 6 1963, DAOM 109223; Cussom Creek, Arrow Park, Ziller 07 8 1958, DAOM 62736; Meager Creek Hotsprings, Kroeger 06 14 1987, UBC F12874; Mount Seymour, North Vancouver, Waugh 05 27 1961, UBC F3242; Confederation Park, Vancouver, Waugh 06 5 1952, DAOM 29531; west of Sooke, Vancouver Island, Ziller 06 15 1971, DAOM 134985; near Sooke, Vancouver Island, Egger 07 10 1982, DAOM 199830; Hastings, Macoun 04 24 1889, DAOM 44702; BC, Burda 07 9 1983, UBC F11957. **USA: Washington:** Big Fir area near Nooksack, Mount Baker National Forest, Isaacs (Is 1790) 07 13 1962, WTU; Upper Baker trail, North Cascades N.P., Williams (JWL 199) 06 29 1969, WTU; Boulder Creek near Baker Lake, Leuthy (Brough 82) 06 21 1957, WTU; North Fork Quinault River, Olympic N.P., Stuntz (Stz 6725), WTU; above Jackson Guard Station, Olympic N.P., A.H. Smith (13378) 05 13 1939, K; Hoh River, Olympic National Forest, A.H. Smith (13172) 05 7 1937, DAOM 24717, K; Hoh River, Olympic National Forest, Kveruvik (Stz 20928) 05 18 1980, WTU; Mount Rainier N.P., Imshaug (488) 07 21 1948, K; Carbon River, Mount Rainier N.P., Cohen (Stz 6824) 07 7 1952, WTU; Round Pass, Mount Rainier N.P., Knowles (Stz 3900) 08 9 1948, WTU; Mount Adams area, Rafauelli (Stz 18846) 07 12 1975, WTU; Tucannon River, Garfield Co., Shaw 07 10 1948, WSP CS25652; White Horse, Snyder (15) 05 15 1932, WTU; Meadowdale, Snyder 05 10 1934, WTU; Muck Creek area, van de Bogart (FVB 1920) 07 16 1973, WTU; Washington, van de Bogart (FVB 1926) 06 25 1973, WTU; unknown, PSMS (Stz 17982, 18407, 21387) 08 1973, 1974, 06 8 1981, Mackintosh (Stz 17874) 05 1973, Leuthy (Stz 20585) 06 1979, (Stz 14513, 14830, 20622) 07 1968, 07 1979, WTU. **Idaho:** Canyon Creek, Priest River Experimental Forest, Bonner Co., Slipp 07 6 1941, WSP 49805; Boulder Creek, Priest River Experimental Forest, Harrison 08 10 1964, DAOM 107197; Gold Creek north of Nordman, Miller 07 4 1964, WSP 54388; Binarch Creek, Bonner Co., Miller 07 8 1964, WSP 54345; Granite Creek, Bonner Co., Slipp 07 4 1939, 07 1 1942, WSP 49763, 49872; Station 1, Bonner Co., Slipp 1942, WSP 49910; Kaniksu National Forest, Bonner Co., Shaw 06 17 1948, WSP CS25646; near Emida, 06 23 1955, WSP 45128; east of Elk River, Clearwater Co., Paden 06 24 1965, WSP 56263; east of Pierce, Shaw 07 9 1959, WSP 48896; north of Bear Basin, Valley Co., Miller 07 24 1964, WSP 54640; Brundage Reservoir, Valley Co., Miller 08 6 1964, WSP 54168; Sater Meadows, Valley Co., Miller 08 6 1964, WSP 54201; No Business Ridge, Valley Co., Hawker 08 1962, K; south of No Business Lookout, Valley Co., Miller 07 23 1964, WSP 54597. **Oregon:** Lake Creek, Grayback area, Siskiyou Mountains, Whittaker 07 14 1949, WSP 25463. **California:** California, Harkness, Herbarium Cooke, K (holotype); Squaw Valley Creek, Mount Shasta, Cooke 07 10 1947, WSP 20304; Lower Panther Creek Meadows, Mount Shasta, Cooke 08 24 1949, WSP 25295. **Exsiccata:** Ellis and Everhardt, North American Fungi, 2737, BC, Canada, Macoun 06 28 1892, s.n. *Helvella californica*, K; University of California, California Fungi, 315, Jonesville, California, USA, Copeland 07 1929, s.n. *Elvella californica*, WSP 35289, TRTC; University of California, California Fungi, 317, Jonesville, California, USA, Copeland 07 1929, s.n. *Elvella umbraculiformis*, WSP 35269, WTU, TRTC.

Pseudorhizina sphaerospora (Peck) Pouzar, 1961, Ceská Mykologie 15: 42.

≡*Helvella sphaerospora* Peck, 1875, Annual Report. New York State Museum 27: 106.

≡*Gyromitra sphaerospora* (Peck) Saccardo, 1889, Sylloge fungorum omnium hucusque cognitarum 8: 16.

≡*Helvellella sphaerospora* (Peck) S. Imai, 1932, The Botanical Magazine (Tokyo) 46: 174.

(additional synonyms see Eckblad 1968).

Type Material: unknown (?NYS).

Figs. 14a,b, 26b, 41.

Apothecium: 8-90 mm diam, 5-35 mm high, irregularly convex, saddle-shaped, or lobed, margin strongly reflexed at all stages, free from stipe, hymenium medium brown to dark or blackish brown fresh, dark brown to black dried, rarely slightly mottled with lighter and darker shades of brown, margin sometimes slightly paler brown, undulate-rugose, excipular surface white to cream or pale grey brown, pubescent, with narrow-edged ribs continuous from stipe extending half to almost all the way to the margin. **Stipe:** 5-60 x 4-40 mm, often enlarged at base, less frequently equal or tapered to base, flaring and merging with apothecium at apex, white to cream, often with strong wine red tints at base or less frequently extending over lower two thirds of stipe, pubescent, deeply ribbed, ribs widely spaced, sharp-edged, in cross section sulcate and solid or with few chambers. **Asci:** 100-150 x 10-16.3 µm. **Paraphyses:** 4-7.5 µm diam. at apex, narrowly clavate, expanded gradually to apex, brown in mass, contents finely granular. **Ascospores:** 8.5-10.3 µm diam., globose, hyaline, smooth, with SEM very finely rugose, uniguttulate, one de Bary bubble in most spores at maturity.

Habitat: Solitary to gregarious or scattered and numerous on very rotted deciduous (or rarely coniferous) logs or woody debris, in deciduous or mixed woods. Associated trees: *Populus balsamifera, Populus tremuloides, Acer negundo, Betula papyrifera, Picea glauca*, and *Abies balsamea*. Often associated with mosses, especially feather mosses (*Hylocomium splendens* and *Pleurozium schreberi*). Fruiting from June 3 to July 6 in AB.

Distribution: Infrequent in boreal regions in the eastern portion of the study area from AB, SK and MB. Known distribution in North America is extended north to Wood Buffalo National Park, AB, and west to Carson Lake, AB. Reported from MT by Cummins (1930, as *Helvella sphaerospora*), but no specimen in MICH could be located. Also distributed in eastern North America (Pomerleau 1980; Weber 1988), Europe (Pouzar 1961; Huhtinen 1983; Torkelsen 1985), and Asia (Imai 1954, as *Helvellella sphaerospora*). Map 8.

Notes: Easily distinguished from other epigeous members of the family because of its small globose spores. *Pseudorhizina sphaerospora* is macroscopically similar to *P. californica* (q.v.), but can be separated by spore shape and its habit of growing on deciduous logs. *Pseudorhizina californica* is primarily terrestrial and associated with conifers. Furthermore, *P. californica* is restricted to areas west of the continental divide in the Rocky Mountains. *Pseudorhizina sphaerospora* is found east of the Rocky Mountains in North America, Europe, and Asia.

Collections Examined: **CANADA: Alberta:** east of Garden Creek, Wood Buffalo N.P., Currah (RC 94-18) 06 9 1994, ALTA 9279; Fawcett Lake, Abbott (SA 38) 06 17 1989, SA; Cross Lake P.P., Abbott (SA 1011) 06 23 1994, SA; Shaw Lake, Abbott (SA 349, 350, 351, 352, 367) 06 4 & 23 1990, SA; Lac La Biche forest, Crites (SA 931, 932, 933) 06 3 & 6 & 23 1992, ALTA; Sir Winston Churchill P.P., Abbott (SA 1155) 06 19 1996; Carson Lake, Wong & Beliveau 07 6 1972, ALTA 7158; Whitemud Creek, Edmonton, Abbott 06 1985, ALTA 8263; Elk Island N.P., Lumley (SA 1145) 06 7 1996, K. **Saskatchewan:** Prince Albert N.P., Zelmer (PA 90) 1994, ALTA. **Manitoba:** Gorge Creek trail, Riding Mountain N.P., Hammerslay 06 30 1979, DAOM 182247; Victoria Beach, Bisby 06 22 1935, DAOM 206813, IMI 26845; Elk Island, Lake Winnipeg, Bisby 06 30 1924, DAOM 206829, 154797. **POLAND**: Biatowieza, Skirgiello 05 1957, K.

Rhizina Fries : Fries, 1823, Systema Mycologicum 2: 32.

Type Species: *Rhizina undulata* Fries, 1823, Systema Mycologicum 2: 33. (monotypic).

Macroscopic Features: ascocarp epigeous, sessile, adjacent fruiting bodies often fused; apothecium discoid or reflexed to convex; hymenium undulate-rugose, brown to red brown, margin yellow to pallid; excipulum with white to yellow rhizoids projecting to substratum; flesh relatively thick, 2-4 mm. **Microscopic Features:** asci cylindrical, tapered to base, hyaline, operculate; paraphyses clavate, hyaline, with dark encrusted pigment; thick-walled brown setae in hymenium arising from excipular tissue; ascospores narrowly fusoidal, rough, with SEM rugose, apiculate, with solitary pointed apiculi, with SEM apiculi twisted-striate (Figs. 43, 44); tetranucleate, typically biguttulate, sometimes with two smaller polar guttules in addition to two central guttules, de Bary bubbles in a small proportion of mature spores (Fig. 26), cyanophilic perispore-periplasm complex present at maturity; excipulum of *textura intricata* throughout at maturity.

Rhizina undulata Fries: Fries, 1823, Systema Mycologicum 2: 33.

≡*Rhizina undulata* Fries, 1815, Observationes Mycologicae 1: 161.
=*Rhizina inflata* (Schaeffer) P. Karsten, 1885, Acta Societatis pro Fauna et Flora Fennica 2: 112. (*fide* Eckblad 1968).
=*Rhizina zonata* Berkeley (holotype K, examined).
(additional synonyms see Eckblad 1968; Seaver 1928).

Type Material: unknown.

Figs. 22, 26a, 43, 44.

Apothecium: 14-86 mm diam. (up to 100 mm diam. fresh), discoid to convex and reflexed, margin expanded to reflexed at maturity, sometimes fused with adjacent apothecia, hymenium medium to dark red brown fresh to blackish brown when dried, undulate-rugose, typically with a distinct white to yellow or yellow brown marginal zone, excipular surface white to pallid brown, finely pubescent, with several to many white, yellow or pallid grey brown rhizoid-like projections extending to substratum and ingrown with debris, up to 30 mm long. **Stipe:** absent. **Asci:** 375-450 x 12.4-19.9 μm. **Paraphyses:** 5.4-7.9 μm diam. at apex, clavate, enlarged gradually to apex, hyaline, with brown encrusted pigment, contents finely granular. **Setae:** 6.6-8.1 μm diam. below, expanded to 8.8-10.9 μm diam. at apex, clavate, enlarged gradually to apex, sometimes somewhat irregularly lobed, brown, thick-walled except apex thin-walled, aseptate. **Ascospores:** 30-45 x 8-15 µm, narrowly fusoidal, hyaline, biguttulate to tetraguttulate, rough, with SEM spore surface rugose, distinctly apiculate, apiculi pointed, appearing twisted with SEM.

Habitat: Solitary to gregarious or numerous and scattered on soil, duff or woody debris, typically in recently burned areas under conifers. Pathogen of conifer seedlings. Associated trees: *Pseudotsuga menziesii, Tsuga heterophylla, Picea mariana, Picea* sp., *Pinus banksiana,* and *Pinus* sp. Fruiting from March in WA to November 21 in BC.

Distribution: Widely distributed, common west of the Rocky Mountains, known from AK, NWT, BC, AB, SK, MB, WA, and ID. A detailed map of the distribution in BC is provided in Ginns (1974a). Reported from MT (Seaver 1928) and OR (Larsen and Denison 1978). Also known from eastern North America (Ginns 1974b), Europe (Breitenbach and Kränzlin 1981), and Asia (Korf and Zhuang 1991). Map 7.

Notes: This species is distinctive because of its indeterminate growth form, excipular rhizoid-like projections, hymenial setae, and ascospore morphology. It is similar to species of *Gyromitra* subgenus *Discina*, and to *G. perlata* (q.v.) in particular because of the discoid to reflexed apothecium, hymenium coloration, and fusoidal, rugose ascospores with large pointed apiculi. The setae are unusual in the family, but similar to the setoid paraphyses of *Helvella crassitunicata*. Large fruitings of this species were seen in northern Alberta in 1996 following the extensive fires of 1995 in the Mariana Lake area south of Fort McMurray.

Collections Examined: **CANADA: Northwest Territories:** South Rutledge Lake, Mackenzie District, Scotter 06 30 1962, DAOM 91443. **British Columbia:** Hazelton, Unger 10 21 1987, DAVFP 23589; Skidegate Lake, Queen Charlotte Islands, Foster 07 29 1943, TRTC; Cariboo Lake, near Likely, Erickson 09 24 1989, DAVFP 24045; Lois Lake, Powell River, Ginns 11 21 1967, DAOM 129015; Lynne Valley Park, North Vancouver, Kroeger 11 18 1981, UBC F10245; Lynne Canyon Park, North Vancouver, Vancouver Natural History Society 09 30 1961, UBC F3490; Stanley Park, Vancouver, Cummings 07 3 1961, UBC F3494; Stanley Park, Vancouver, Kroeger 09 16 1985, UBC F12460; Stanley Park, Vancouver, Waugh 07 28 1952, DAOM 34808; UBC endowment Lands, Vancouver, Brough, Perrin, & Koske 07 5 1969, 07 15 1970, UBC F3491, F3492; UBC endowment Lands, Vancouver, Bandoni 09 12 1969, UBC F1326; Salisbury Lake, Mission, Ginns 11 6 1967, DAOM 119359; Ucluelet, Vancouver Island, Ginns & Allen 11 9 1967, DAOM 126248; Port Renfrew, Vancouver Island, Ginns 11 15 1967, DAOM 119357; Jordan River, Vancouver Island, Ginns 11 15 1967, DAOM 129011; near Sooke, Vancouver Island, Egger 10 13 1983, DAOM 195834, 199775, 199776, 199777; near Sooke, Vancouver Island, Egger 10 26 1983, DAOM 199656, 199657, 199658; Brothers Creek trail, Hollyburn, Bandoni 10 15 1966, UBC F3493, DAOM 129748, 175778. **Alberta:** north of Mariana Lake, Abbott (SA 1208, 1210) 07 29 1996, SA; Long Lake P.P., States 06 16 1967, ALTA 652. **Saskatchewan**: 15 miles south of Buffalo Narrows, Gautreau 07 10 & 11 1970, CFB 20085, 20089, 20139; 50 miles north of Meadow Lake, Gautreau 07 13 1971, CFB 20576. **Manitoba:** Victoria Beach, Bisby 09 12 1928, DAOM 206821. **Ontario:** Algoma district, Cain 09 13 1956, TUR 73431, TRTC 32453, 34260; Chalk River, Riley 09 11 1941, TRTC 18518. **New Brunswick:** Richibucto, Cain 07 31 1963, WSP 56995, TRTC 41416. **Newfoundland:** Labrador, east of Esker, Heikkilä, Mäkinen, & Kankainen 07 20 1967, TUR 16879, 69218. **USA: Alaska:** Anchorage, Kempton 09 28 1975, WK 6290; Bird Creek south of Anchorage, Kempton 08 2 1967, WK 1528; Haines, Kempton 09 20 1972, WK 5983. **Washington:** near Longmire, Mount Rainier N.P., Snyder 09 1 1934, WTU; Barlow Pass area, Woo (Stz 16329) 10 28 1978, WTU; near Gold Basin, Builder (Stz 20494) 10 28 1970, WTU; Heart-o-Hills campground, Largent (1932) 10 23 1960, WTU; unknown, Nelson (Stz 16601) 03 1971, WTU. **Idaho:** near junction Benton Creek and Priest River, Rhoads 08 11 1920, MU 4094. **UNITED KINGDOM:** Loch Gallin, Inverness, Scotland, Reid 08 29 1975, K; unknown, Herbarium Berkeley 1879, K (holotype of *Rhizina zonata*). **NETHERLANDS:** Willemsbo, Nunspeet, Gremmen 07 22 1959, CFB 4882. **Exsiccata**: Vancouver Island Fungi, 105, Sidney, BC, Canada, Macoun 1913, s.n. *Rhizina undulata*, UBC F3495.

Tribe Helvelleae Dissing, 1966, Dansk Botanisk Arkiv 25: 28.

Helvella Linnaeus : Fries, 1823, Systema Mycologicum 2: 13.

≡*Helvella* Linnaeus, 1753, Species plantarum 2: 1180. (s.n. *Elvela*)
=*Paxina* Kuntze, 1891, Revisio generum plantarum 2: 864.
=*Acetabula* (Fries) Fuckel, 1869, Symbolae mycologicae 331.
=*Macropodia* Fuckel, 1869, Symbolae mycologicae 331.
=*Cyathipodia* Boudier, 1907, Histoire et classification des Discomycètes d'Europe 39.
=*Leptopodia* Boudier, 1885, Bulletin de la Societé de France 1: 99.
=*Wynnella* Boudier, 1885, Bulletin de la Societé de France 1: 102.
(additional synonyms see Weber 1972; Dissing 1966b).

Type Species: *Helvella crispa* Scopoli : Fries, 1823, Systema Mycologicum 2: 14.

Macroscopic Features: ascocarp epigeous, distinctly stipitate to subsessile; apothecium cupulate, auriculoid, saddle-shaped, convex, or irregularly lobed and reflexed; hymenium smooth to undulate-rugose, white to black or typically shades of grey and brown; excipular surface smooth or ribbed, villose to glabrous; stipe terete to highly fluted or ribbed, villose to glabrous, internally solid, hollow, or chambered; flesh relatively thin, 1-2 mm. **Microscopic Features:** asci cylindrical, tapered to base, hyaline, operculate, ascus base aporhynchous or pleurorhynchous; paraphyses clavate, hyaline to dark brown, contents finely granular; ascospores broadly ellipsoidal or rarely subfusoidal, hyaline, smooth with light microscope, finely rugose or rarely finely verrucose with SEM, non-apiculate, tetranucleate, uniguttulate or rarely triguttulate, de Bary bubbles absent; apothecial tissues clearly separated into medullary and ectal excipulum, medullary excipulum of *textura intricata*, ectal excipulum of *textura angularis* or *prismatica*, often with long chains of cells forming fascicled hyphal tufts on the ectal excipular surface.

Key to subgenera of *Helvella*

1. Apothecia convex to irregularly lobed.. 2
1'. Apothecia cupulate to auriculoid (like a rabbit's ear)................................... 3
  2. Stipe strongly ribbed, internally chambered....................**subgen.** ***Helvella***
  2'. Stipe terete to sparingly fluted, internally solid or hollow....**subgen.** ***Elasticae***
3. Apothecium auriculoid (erect, elongate, one-sided apothecium,
    reminiscent of a rabbit's ear)..................................**subgen.** ***Silvicolae***
    ....***(H. silvicola)***
3'. Apothecium cupulate.. 4
  4. Stipe distinctly ribbed; stipe prominent or apothecium appearing
    subsessile and gathered at base; stipe typically expanded
    (flared) at apex..**subgen.** ***Leucomelaenae***
  4'. Stipe terete to shallowly fluted; stipe discrete (elongate or short);
    stipe typically not enlarged noticeably at apex...................................... 5
5. Ascospores broadly ellipsoidal, uniguttulate, smooth (finely
    rugose by SEM)..**subgen.** ***Cupuliformae***
5'. Ascospores subfusoidal to fusoidal, typically triguttulate (rarely
    uniguttulate), verruculose (verrucose by SEM)...........**subgen.** ***Macropodes***
    ....***(H. macropus)***

Helvella **Subgenus** ***Cupuliformae*** S.P. Abbott *subgen. nov.*

Apothecia cyathiforme, extra pubescens vel villosum; stipes tereti, pubescenti vel villoso; ascosporae late ellipsoideae, uniguttulatae.

Type Species: *Helvella cupuliformis* Dissing & Nannfeldt, 1966, Svensk Botanisk Tidskrift 60: 326.

Ascocarp: cupulate, stipitate; hymenium medium grey brown to black, smooth; excipular surface lacking ribs, pubescent to villose; stipe terete to shallowly fluted, internally solid. **Asci**: pleurorhynchous. **Ascospores**: broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate, with large, central, broadly ellipsoidal oil guttule.

Notes: Ascospores are broadly ellipsoidal, uniguttulate, and are finely rugose with SEM. This subgenus includes small species with regularly cupulate apothecia and terete or indistinctly fluted stipes and includes some species in section *Macropodes* (*sensu lato* of Dissing 1966b) and section *Ephippium* of Häffner (1987).

Key to species of *Helvella* subgenus *Cupuliformae*

1. Ascocarp black; stipe indistinctly ribbed..***H. corium***
1'. Ascocarp grey brown; stipe terete or shallowly fluted.................................. 2
    2. Stipe relatively short (length less than apothecium diameter) and stout (up to 5 mm diam.).....................................***H. cupuliformis***
    2'. Stipe relatively long (length equal to or greater than apothecium diameter) and slender (up to 2 mm diam.)... 3
3. Apothecium dark brown, small (3-9 mm diam.)..........................***H. rivularis***
3'. Apothecium medium to dark grey brown, larger (10-25 mm diam.)...***H. chinensis***

Helvella chinensis (Velenovsky) Nannfeldt & L. Holm, 1985, in Lundell, Nannfeldt and Holm, Publications of the Herbarium University of Uppsala 18:5.

≡*Macropodia chinensis* Velenovsky, 1939, Novitates Mycologicae p. 200.

≠*Helvella sinensis* B. Liu & J.Z. Cao, 1985, in Liu, Du and Cao, Acta Mycologica Sinica 4: 214. (later homonym, *fide* Zhuang 1995).

= *Helvella dissingii* Korf, 1988, Mycotaxon 31: 381.

≡*Octospora villosa* Hedwig, 1789, Species Muscorum Frondosorum 2: 54, Table19 Figure B.

≡*Helvella villosa* (Hedwig ex Kuntze) Dissing & Nannfeldt, 1966, Svensk Botanisk Tidskrift 60: 330 (illegitimate, later homonym); non *Helvella villosa* Schaeffer, 1774, Fungorum qui in Bavaria et Palatinatu circa Ratisbonam nascuntur icones 4: 114. (*nomen dubium, ?=Thelephora hirsuta*).

=*Helvella pallidula* N.S. Weber, 1972, The Michigan Botanist 11: 171. (holotype MICH, examined).

(additional synonyms see Dissing 1966b as *H. villosa*).

Type Material: Holotype PR.

Fig. 48.

Apothecium: 10-25 mm diam., 5-10 mm high (up to 30 mm diam. fresh), shallowly cupulate to plane, sometimes laterally compressed initially, rarely reflexed-convex in age, hymenium grey to grey brown when dried, smooth, excipular surface grey brown, villose to densely pubescent. **Stipe**: 11-30 x 1-5 mm (up to 40 mm long fresh), equal or apex tapered slightly, grey brown, densely pubescent, terete and solid. **Asci**: 240-260 x 17-19 µm. **Paraphyses**: 5-7.5 µm diam. at apex, clavate, enlarged gradually to apex, hyaline to pale brown. **Ascospores**: 16.5-20 x 10-12 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary to gregarious or scattered and numerous on litter in deciduous, mixed, or coniferous woods. Associated trees: *Pseudotsuga menziesii, Picea* sp., *Arbutus menziesii, Populus balsamifera, Betula* sp., *Alnus* sp., *Arctostaphylos* sp. and *Acer* sp. Fruiting from April 9 in ID to October 26 in WA.

Distribution: Widely distributed in boreal, montane, and coastal regions from AK, AB, WA, and ID. Also in eastern North America (Weber 1972, as *H. villosa* and *H. pallidula*), Europe (Dissing 1966b; Dissing and Nannfeldt 1966, as *H. villosa*), Asia (Dissing 1966b; Cao 1988, as *H. villosa*) and Australia (Rifai 1968, as *H. villosa*). Map 18.

Notes: The species is closely related to *H. cupuliformis* (q.v.) which is distinguished by the yellow colour of dried ascocarps and short robust stipe, and *H. rivularis* (q.v.) with smaller, dark brown ascocarps. Macroscopically, it is very similar to *H. macropus* (q.v.) in subgenus *Macropodes*, resulting in some confusion and misidentification of herbarium specimens, but ascospore morphology separates them easily. Colour and habit of *H. chinensis* are similar to *H. solitaria* (q.v.), but *H. chinensis* never has prominent ribbing of the stipe and is always small. This species provides a definite link with members of the subgenus *Elasticae*, and is closely related to *H. ephippium* (q.v.) which is similar in stature and colour but has a more complex, lobed apothecium, typical of the subgenus.

Although this taxon has been referred most commonly to *H. villosa*, Korf (1988) rejected the name *H. villosa* as a later homonym and renamed the species *H. dissingii* based on the lectotype (iconotype) of *Octospora villosa* Hedwig. *H. dissingii* is a later synonym of *H. chinensis. Helvella pallidula* was described by Weber (1972) based on the pale ascocarp colour. No correlative features were provided in the original description and none was found in this study during examination of the holotype. Pale specimens of *H. chinensis* (reported as *H.* cf. *pallidula* by Kristiansen 1983) were also examined from Norway (RK 83.136) in the same locality as typical specimens of *H. chinensis*. Colour variants also occur in *H. lacunosa* (q.v.), *H. maculata* (q.v.), and *H. latispora* (q.v.).

Collections Examined: CANADA: Alberta: Fish Creek P.P., Calgary, Danielson (RMD 1300) 09 16 1973, ALTA 8289. **USA: Alaska**: Eklutna Lake north of Anchorage, Kempton 09 21 1971, WK 5612; Birchwood, north of Anchorage, Kempton 08 11 1969, WK 4127; butte area south of Palmer, Kempton 08 8 1960, WK 1562. **Washington**: Friday Harbor, San Juan Island, Stuntz (Stz 11771, 12360) 06 18 1960, 06 11 1961, WTU; Mount Constance, Olympic N.P., Stuntz (Stz 3614) 07 8 1948, WTU; Tenino south of Olympia, Bennedict (Is 1753) 05 30 1962, WTU; P.P.P., Leatham (Stz 15087) 10 26 1968, WTU. **Idaho**: Upper Priest River, Bonner Co., Smith (NJS 2101) 10 1 1968, MICH; Fall Creek, French Creek Grade, Idaho Co., Smith (AHS 70096) 04 9 1964, MICH. **Michigan:** Montmorency Co., Smith (NJS 397) 07 24 1967, MICH (holotype of *H. pallidula*). **Iowa**: Iowa City, Martin 06 29 1941, UBC F3318; Decorah, Holway 09 1882, NY. **Pennsylvania**: Bethlehem, Ellis 07 1883, NY. **Missouri**: Meramec Heighlands, Saint Louis, Glatfelter 06 12 1909, NYS. **NORWAY**: Østfold, Hvaler, Kirkeøy, Ørdal, Kristiansen 09 9 1988, 09 24 1989, RK 88.33, 89.94; Østfold, Hvaler, Kirkeøy, Grønvoll-Ørdal, Kristiansen 09 13 1986, RK 86.110; Østfold, Hvaler, Kirkeøy, near Brekke, Kristiansen 07 3 1983, 07 7 1985, 09 9 1988, RK 83.136, 85.07, 88.34; Østfold, Hvaler, Asmaløy, Enerstad, Kristiansen 08 31 1988, RK 88.26; Østfold, Kråkerøy, near Allerød, Kristiansen 10 4 1988, RK 88.44. **SWEDEN**: Halland, Onsala parish, Presse, Björkhamra, Karlvall (6944) 07 8 1956, K. **Exsiccata**: Ellis and Everhardt Fungi Columbiani, 1219, London, Canada, Dearness 08 1897, s.n. *Peziza subclavipes*, NY, K; Ellis North American Fungi, 985, Newfield, New Jersey, USA, 06 and 09 1882, s.n. *Peziza subclavipes*, NY (packet C).

Helvella corium (Weberbauer) Massee, 1895, British Fungus Flora 4: 463.

≡*Peziza corium* Weberbauer, 1873, Die Pilze Norddeutschlands mit besonderer Berücksichtigung Schlesiens 1: 7, Table 3 Figure 7a-d.

=*Helvella arctica* Nannfeldt, 1937, Svensk Botanisk Tidskrift 31: 60. (isotype K, examined).

(additional synonyms see Dissing 1966b).

Type Material: Holotype WRSL, examined.

Fig. 47.

Apothecium: 3-25 mm diam., 2-10 mm high (up to 40 x 12 mm fresh), deeply to shallowly cupulate, margin inrolled initially, expanding at maturity, hymenium black (fresh and dried), smooth, excipular surface black or blackish brown, often with white to greyish white marginal pubescence, densely pubescent to villose near margin, smooth or rarely with ribs extending onto basal quarter of excipular surface. **Stipe**: 2-29 x 0.5-8 mm (up to 40 mm long fresh), equal or enlarged at base, black or very dark brown, often white or pale grey at base, pubescent, terete or often slightly fluted especially at base, rarely strongly ribbed, terete or slightly sulcate and solid. **Asci**: 225-250 x 12.2-17 µm. **Paraphyses**: 4.1-8 µm diam. at apex, clavate, enlarged gradually to abruptly at apex, brown, contents finely granular. **Ascospores**: 16.1-20.6 x 9.4-13 (15) µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary or typically gregarious to numerous and scattered, often on bare soil, typically with willows in deciduous or mixed woods or tundra. Associated trees: *Populus tremuloides* and *Thuja plicata*. Associated shrubs: *Salix herbacea, Salix glauca, Salix* spp., *Shepherdia canadensis,* and *Dryas* sp. Fruiting period from May 20 in WA to September 28 in AK. June to August collections are typical.

Distribution: Widely distributed but uncommon in boreal, montane, alpine, coastal, and arctic regions from AK, YT, NWT, BC, AB, SK, MB, WA, and ID. This species is newly reported for NWT and SK. Reported from OR by Larsen and Denison (1978). Also in eastern North America (Weber 1972), Europe (Dissing 1966b; Häffner 1987; Schumacher and Mohn Jenssen 1992), and Asia (Liu *et al.* 1985). Map 17.

Notes: This species is characterized by its cupulate apothecium, black ascocarp, densely pubescent excipulum, and terete to shallowly fluted stipe. Other black species include *H. atra* (q.v.), *H. pezizoides* (q.v.), and *H. lacunosa* (q.v.), all of which have an irregular, lobed apothecium. *Helvella arctica* was distinguished by the white marginal pubescence by Nannfeldt (1937) and Dissing (1964), but the variability of this feature was later recognized (Dissing 1966b). White marginal pubescence is not seen in all individuals and tends to be more pronounced in arctic or alpine collections. White marginal pubescence occurs in other arctic and alpine taxa including *H. verruculosa* and *H. aestivalis*. Dark specimens of *H. verruculosa* may appear similar, but can be differentiated by the strongly ribbed stipe with ribs extending onto the excipular surface. The morphological similarities among *H. corium*, *H. verruculosa,* and *H. solitaria* suggests an affinity with the subgenus *Leucomelaenae*.

Collections Examined: CANADA: Yukon: Dempster Highway near Dawson, Ginns 07 2 1982, DAOM 195465; east of Dawson, Calder & Billard 06 24 1949, DAOM 25983; near Conglomerate Mountain, Ginns 06 29 1984, DAOM 195291. **Northwest Territories**: 50 km northwest of Dickson Canyon, District of Mackenzies, UNL 07 19 1977, UVIC; Thelon River, Baker Lake, Ohenoja 08 16 1974, DAOM 155327; Coral Harbor, Southampton Island, Savile 08 16 1959, DAOM 67074. **British Columbia**: UBC endowment lands, Vancouver, Redhead 06 3 1970, UBC F3390. **Alberta**: Clifford E. Lee Natural Area, Abbott (SA 1091) 08 19 1995, SA; Devonian Botanic Garden near Devon, Currah 08 20 1985, ALTA 8267; Athabasca Glacier, Columbia Ice Fields, Jasper N.P., Abbott (SA 373) 08 2 1990, SA; near Banff, Banff N.P., Danielson (RMD 1644) 08 10 1975. **Saskatchewan**: Prince Albert N.P., Zelmer (PA 485, 489, 961) 07 12 1995, ALTA; Saskatoon, Ledingham 07 7 1934, DAOM 206816. **Manitoba**: Victoria Beach, Bisby 06 23 1928, DAOM 206815. **Ontario**: Bow Lake, Madawaska Mines, Malloch & Lahaie 06 16 1979, TRTC 48416. **Québec**: Kuujjuarapik, Great whale River, Poste-de-la-Baleine, Huhtinen 08 24 1982, TUR 78759; north of airport, Schefferville, Kankainen 07 10 1967, TUR 53425, 78760; McGill Subarctic Research Station, Schefferville, Kallio 07 19, 31 1978, TUR 78714, 78727; north end of Knob Lake, Schefferville, Kallio 07 20 1978, TUR 69168. **Newfoundland**: Labrador, between Schefferville and the

Indian village, Mäkinen 07 8 1967. **USA**: **Alaska**: Livengood road near Fairbanks, Kempton 08 18 1971, WK 5336; Birch Lake near Fairbanks, Kempton 08 22 1966, WK 1530; Fielding Lake near Paxon Lake, Kempton 09 3 1973, WK 6055; near Nome on Seward Peninsula, Kempton 08 13 1981, WK 6407; Earthquake Park, Anchorage, Kempton 08 11 1976, WK 6315; Alaska Pacific University campus, Anchorage, Kempton 08 8 & 09 28 1971, 06 28 1972, WK 5235, 5670, 5815; Caswell Creek, Susitna River valley, Kempton 06 20 1970, WK 4388; near Sterling on Kenai Peninsula, Kempton 08 13 1981, WK 6407; Katmai National Monument on Alaska Peninsula, Kempton 09 6 1971, WK 5489; Anchorage Cove, Glacier Bay National Monument, Sprague 08 9 1952, WSP AS33709; Forest Creek, Glacier Bay National Monument, Sprague 08 15 1952, WSP AS33716, AS33719. **Washington**: Naches Pass area, Laycock 05 20 1987, WTU. **Idaho**: Payette Lake, Valley Co., Smith & Bigelow (AHS 44224, 44434, 44847, 45154) 06 26 & 30, 07 10 & 18 1954, MICH. **Wisconsin**: Madison, Harper 05 27 1904, WSP 52063; Columbia National Forest, Lewis Co., 07 9 1948, WSP 19572, 28587. **SVALBARD**: Loven Glacier, Currah 08 12 1988, ALTA. **SWEDEN**: Torne Lappmark, Jukkasjärvi parish, Abisko, Nannfeldt (1523) 07 8 1928, K (isotype of *H. arctica*). **POLAND**: Georgenberg Landeck, Weberbauer 05 1870, 1871, 1873, WRSL (holotype, authentic material). **Exsiccata:** Bartholomew, Fungi Columbiani, 2329, Denver, Colorado, USA, Bethel 05 1905, s.n. *Macropodia corium*, WSP 3425.

Helvella cupuliformis Dissing & Nannfeldt, 1966, Svensk Botanisk Tidskrift 60: 326.

Type Material: Holotype UPS, examined; paratype K, examined.

Fig. 58.

Apothecium: 9-35 mm diam., 4-16 mm high, deeply cupulate initially, expanding to shallowly cupulate at maturity, margin inrolled initially, sometimes splitting in age, hymenium dark brown to grey brown when dried, smooth, excipular surface grey brown, paler than hymenium, densely pubescent to villose. **Stipe**: indistinct to prominent, 2-10 x 2-8 mm, equal, white to cream or light grey brown near apex, densely pubescent to villose (especially at apex), terete or slightly fluted, internally solid. **Asci**: 250-300 x 15-17 µm. **Paraphyses**: 4.3-6.6 µm diam. at apex, clavate, enlarged gradually to apex, pale brown to brown in mass, contents finely granular. **Ascospores**: 18.4-21.0 x 11.4-12.2 µm, broadly ellipsoidal to ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Gregarious on clay soil under *Arbutus menziesii* and *Arctostaphylos* sp. Collected only on March 24 in OR.

Distribution: Rare in the cascade range of OR. Also distributed in eastern North America (Weber 1972), Europe (Dissing 1966b; Dissing and Nannfeldt 1966), and Asia (Tewari *et al.* 1971). Map 17.

Notes: This species is closely related to *H. chinensis* (q.v.) and *H. rivularis* (q.v.), but is separated by ascocarp colour, the relatively short stout stipe, and slightly longer ascospores. The collection ascribed to *H. cupuliformis* by Kempton and Wells (1970) belongs to *H. albella* (q.v.). North American collections reported here differ from European ones in being vernal. Differences in paraphysis staining in Cotton Blue between *H. cupuliformis* and *H. villosa* (=*H. chinensis*) reported by Dissing and Nannfeldt (1966) were not confirmed in this study.

Collections Examined: USA: Oregon: reservoir hill, Gold Hill, Stuntz (Stz 10939) 03 24 1959, WTU. **Texas**: Tyler, Harris 05 1892, NY. **South Carolina**: Aiken, Ravenel (922b), NY. **SWEDEN**: near Kåbo, Uppsala, Uppland, Ridelius 07 30 1936, UPS (holotype); near Skogshall, Uppsala Stadsskogen, Uppland, Eriksson & Morander 07 7 1948, K (paratype). **SWITZERLAND**: Arosa, Rahm 10 21 1963, K. **Exsiccata**: Ravenel Fungi Americani Exsiccati, 760, Aiken, South Carolina, USA, Ravenel, s.n. *Peziza* (*Sarcoscypha*) *corium*, NY; Ellis North American Fungi, 984, Aiken, South Carolina, USA, Ravenel, s.n. *Peziza corium*, NY.

Helvella rivularis Dissing & Sivertsen, 1980, Botanisk Tidsskrift 75: 101.

Type Material: Holotype TRH; isotype C, examined.

Fig. 10.

Apothecium: 3-9 mm diam., 2-5 mm high (up to 18 x 9 mm fresh), deeply cupulate to cupulate, margin inrolled initially, hymenium dark grey brown to dark brown fresh, when dry blackish brown, smooth, excipular surface dark grey brown to dark brown, when dried dark brown to blackish brown, densely pubescent to villose, vestiture often tufted. **Stipe**: 2-5 x 1-2 mm (up to 10 x 2.5 mm fresh), equal, medium grey brown to brown, when dry dark brown, pubescent, terete and internally solid. **Asci**: 13.5-15.6 μm diam. **Paraphyses**: 2.4-6.2 μm diam. at apex, clavate to nearly equal, gradually enlarged to apex, pale brown, contents finely granular. **Ascospores**: 17.0-20.1 x 10.5-12.9 μm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary to gregarious on bare soil or mossy humus in mixed woods. Associated trees: *Populus tremuloides, Populus balsamifera, Betula papyrifera,* and *Picea glauca*. Associated shrubs: *Salix discolor*. Fruiting from July 6 in AB to September 19 in the NWT.

Distribution: Rare in boreal and arctic regions from AB and NWT. This species is newly reported for North America; previously known in Europe from Scandinavia and Greenland (Dissing and Sivertsen 1980) and Asia (Cao *et al.* 1990). Map 18.

Notes: *Helvella chinensis* (q.v.) is similar, but has larger, grey apothecia, with a more elongate stipe, and has a finer vestiture on the excipulum. Häffner (1987) suggests that *H. rivularis* may be conspecific with *H. villosa* (=*H. chinensis*), but specimens examined are morphologically distinct and are tentatively retained as separate species. *Helvella macropus* (q.v.) shares the villose excipulum with tufted and fascicled hairs, but is paler in colour and has larger, subfusoidal, verrucose ascospores. The description provided here based on North American specimens matches the features of the holotype in all respects, although the holotype specimens reach 12 mm diam., and a stipe size of 9 x 2 mm.

Collections Examined: CANADA: Northwest Territories: Gull Creek, Inuvik area, Huhtinen 09 19 1984, TUR 98400. **Alberta**: Notikewin P.P., Abbott (SA 134) 08 7 1989, SA; Iosegun Lake east of Fox Creek, Abbott (SA 128) 08 6 1989, SA; Wagner Natural Area, Hill-Rackette (SA 940) 07 6 1994, SA. **NORWAY**: Nordland, Rana, Krokstrand, Tørbekken, Dissing & Sivertsen (72.95) 09 7 1972, C (isotype); Østfold, Skjeberg, Hafslund parken, Kristiansen 08 11 & 16 1986, RK 86.45; Østfold, Kråkerøy, Tørkopp, Kristiansen 09 1 1986, RK 86.93; Østfold, Hvaler, Kirkeøy, Ordal, Kristiansen 08 29 1987, RK 87.45.

Helvella Subgenus *Elasticae* (Dissing) S.P. Abbott *comb. nov.*

≡*Helvella* section *Elasticae* Dissing, 1966, Dansk Botanisk Arkiv 25: 128.

=*Helvella* section *Ephippium* Dissing, 1966, Dansk Botanisk Arkiv 25: 114.

Type Species: *Helvella elastica* Bulliard : Fries, 1823, Systema Mycologicum 2: 21.

Ascocarp: stipitate; apothecium irregularly lobed to saddle-shaped or reflexed, margin inrolled initially or reflexed initially; hymenium pale, medium, or dark brown to grey or black, smooth to somewhat undulate-rugose; excipular surface white to black, villose to glabrous, lacking ribs; stipe white to black, equal or enlarged at base, apex typically tapered, terete to fluted but not ribbed, internally terete to slightly sulcate and solid to hollow. **Asci**: pleurorhynchous. **Ascospores**: broadly ellipsoidal, smooth, with SEM finely rugose, uniguttulate, with large central broadly ellipsoidal oil guttule.

Notes: The subgenus includes all species in the sections *Elasticae* and *Ephippium* of Dissing (1966b), but only some in section *Ephippium* of Häffner (1987)(see also comments under subgenus *Cupuliformae*). The genus *Leptopodia* (*sensu* Boudier 1907), based on *H. elastica*, included many of the species ascribed to this subgenus, but not *H. monachella* (= *H. leucopus*) which was retained in the genus *Helvella sensu stricto*.

Key to species of *Helvella* subgenus *Elasticae*

1. Apothecia and stipe black (or very dark grey brown).. 2
1'. Apothecia light, medium, or dark grey to brown; stipes white to light grey brown.. 3
    2. Excipular surface pubescent to villose; apothecial margin strongly inrolled initially, typically remaining somewhat incurved at maturity...***H. pezizoides***
    2'. Excipular surface finely pubescent to glabrous; apothecial margin only slightly incurved initially, soon becoming reflexed to strongly reflexed at maturity..***H. atra***
3. Apothecial margin reflexed initially and at maturity; excipular surface glabrous at all stages; stipe hollow..***H. elastica***
3'. Apothecial margin inrolled initially, remaining inrolled, incurved, or becoming reflexed at maturity; excipular surface finely pubescent to villose initially, remaining distinctly pubescent or becoming glabrous at maturity; stipe solid or rarely hollow.. 4
    4. Excipular surface densely pubescent to villose.. 5
    4'. Excipular surface finely pubescent or glabrous.. 6
5. Stipe grey brown, at least in dried condition; apothecium (up to 10 mm diam.) and stipe (up to 15 x 2 mm) relatively small.................***H. ephippium***
5'. Stipe white to cream in fresh and dried condition; apothecium (up to 20 mm diam.) and stipe (up to 50 x 6 mm) relatively large........***H. compressa***
    6. Hymenium pale brown to light yellow brown when dried; ascospores 16.5-21 µm long..***H. latispora***
    6'. Hymenium medium to dark grey brown to brown or blackish brown when dried; ascospores 18.5-23.5 µm long......................***H. albella***

Helvella albella Quélet, 1896, Compte Rendu Assoc. Franc. Avancem. Sci. Conf. (Bordeaux, 1895) 24: 621.

≡*Leptopodia albella* (Quélet) Boudier, 1904-1911, Icones mycologicae, ou iconographie des champignons de France 4: 123.

Type Material: none available (*fide* Dissing 1966b).

Apothecium: 6-24 mm diam., 5-24 mm high (up to 55 x 50 mm fresh), irregularly lobed to bilobate and saddle-shaped, rarely irregularly discoid initially, margin inrolled to incurved initially, becoming flared to reflexed at maturity, free from stipe, hymenium medium to dark brown or grey brown fresh, when dried dark brown to blackish brown, rarely slightly mottled with paler patches, smooth to slightly undulate-rugose, excipular surface white or pallid greyish white, when dried light grey to pale yellow brown, pubescent to finely pubescent or nearly glabrous in age. **Stipe**: 8-58 x 1-9 mm (up to 100 x 10 mm fresh), equal or enlarged slightly to base, apex typically tapered, white, pale yellow brown when dried, finely pubescent to pubescent, terete or shallowly fluted, internally solid to hollow. **Asci**: 280-330 x 14.4-20.8 µm. **Paraphyses**: 6.0-9.9 µm diam. at apex, terminal cell 35-65 µm long, clavate, enlarged gradually to quite abruptly or irregularly at apex, pale brown to brown in mass, contents finely granular. **Ascospores**: 18.6-23.3 x (10.3) 11.8-13.9 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary to gregarious on ground in coniferous or mixed woods. Associated trees: *Picea glauca, Pinus contorta, Pseudotsuga menziesii, Tsuga* sp., *Betula* sp., *Alnus* sp., *Populus balsamifera,* and *Populus tremuloides*. Associated shrubs: *Salix discolor* and *Betula pumila.* Fruiting from July 17 in Alaska to December 6 in WA.

Distribution: Widely distributed but infrequent in boreal, montane, and coastal regions from AK, BC, AB, WA, and ID. Also distributed in Colorado (Weber 1975), eastern North America (Weber 1972), Europe (Dissing 1966b; Häffner 1987) and Asia (Liu and Cao 1988). Map 21.

Notes: This species is closly related to *H. elastica* (q.v.), but differs in its pubescent excipulum and initially inrolled apothecial margin. In addition, the apothecial margin of *H. albella* is always free from the stipe. Older specimens of *H. albella* with near glabrous excipular surface and reflexed apothecial margin may be difficult to separate from *H. elastica*, but can be identified if submature individuals are present. Ascospore size for the two species listed by Dissing (1966b) and Weber (1972) indicate that *H. albella* has slightly broader ascospores, but this is not confirmed by Häffner (1987) or here. *Helvella elastica* has ascospores of variable width, overlapping the range in *H. albella*. *Helvella latispora* (q.v.) is also close and shares the initially incurved apothecium which becomes reflexed at maturity and the finely pubescent excipulum. These species are easily distinguished by hymenium colour and fruiting time. The apothecial margin of *H. latispora* is also more highly inrolled over the hymenium in immature stages. Lack of extant type material hampers clear delimitation from similar species.

Collections Examined: CANADA: British Columbia: Stone Mountain P.P., Abbott (SA 164) 08 12 1989, SA; Kaslo, Bell 08 18 1959, UBC F3265. **Alberta**: Fawcett Lake, Abbott 09 3 1988, ALTA 8316, 8317; Edmonton, Redhead 09 3 1970, UBC F3268; Glenmore Park, Calgary, Danielson (RMD 274) 09 11 1972, ALTA 8288. **USA**: **Alaska**: Eklutna Lake, Kempton 07 27 1974, WK 6157; Juneau, Kempton 07 30 1966, WK 1587. **Washington**: Seattle, Stuntz 12 6 1934, WTU; Seward Park, Snyder 10 28 1933, WTU; Green Lake, Mount Rainier N.P., Stuntz (Stz 7605) 10 19 1952, WTU. **Idaho**: Priest River Experimental Forest, Bonner Co., Slipp, WSP 49798. **SWEDEN**: Uppsala, Carolinaparken, Melderis 09 30 1945, K. **UNITED KINGDOM**: Quantocks, Somerset, Marrage 09 20 1960, IMI 83231. **GERMANY**: Neuensorgen Forest, Engel (423) 07 25 1974, K.

Helvella atra Holmskjøld : Fries, 1823, Systema Mycologicum 2: 19.

≡*Helvella atra* Holmskjøld, 1790, Beata ruris otia Fungis Danicis impensa 2: 47, Table 25.

=*Helvella subglabra* N.S. Weber, 1972, The Michigan Botanist 11: 179. (holotype MICH, examined).

(additional synonyms see Dissing 1966b).

Type Material: Lectotype in Holmskjøld, 1790, Beata ruris otia Fungis Danicis impensa 2: 47, Table 25, (selected Dissing 1966b).

Figs. 5a, 46.

Apothecium: 3-16 mm diam., 3-18 mm high (up to 30 mm diam. fresh), bilobate to somewhat irregularly lobed, often laterally compressed initially, margin incurved very slightly initially, soon becoming reflexed, sometimes appressed but free from stipe, hymenium black to blackish grey brown (fresh and dried), smooth to undulate-rugose, excipular surface pale to medium grey brown, finely pubescent. **Stipe**: 3-26 x 1-4 mm (up to 50 x 8 mm fresh), equal or enlarged at base, medium grey brown to blackish grey brown, typically yellowish grey to white at base, pubescent, terete or shallowly fluted (especially at base), internally solid, rarely hollow at base. **Asci**: 192-225 x 12.9-17 µm. **Paraphyses**: 4.7-9 µm diam. at apex, terminal cell 11.6-19.3 µm long, clavate, enlarged gradually to abruptly at apex, brown to dark brown in mass, contents finely granular. **Ascospores**: 15-20.6 x 10-13.1 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Gregarious to scattered and numerous on ground or rotted wood in deciduous or mixed woods. Associated trees: *Populus tremuloides*, *Alnus tenuifolia*, *Betula papyrifera, Picea mariana,* and *Larix laricina*. Associated shrub: *Salix discolor*. Fruiting period from July 14 in MT to September 2 in AB.

Distribution: Uncommon in boreal and montane regions of AB and MT. Also in eastern and southern North America (Weber 1972, as *H. subglabra* and *H. atra*), Europe (Dissing 1966b; Häffner 1987), and Asia (Liu *et al.* 1985). Map 23.

Notes: This species is most closely related to *H. pezizoides* (q.v.). *Helvella atra* has a finely pubescent excipulum, slightly incurved apothecial margin at submature stage and reflexed at maturity, and a grey to black ascocarp. Both *Helvella atra* and *H. pezizoides* are occasionally collected from rotted wood and Häffner (1987) suggests they may be synonymous. The species are certainly closer to each other than to other species in the genus, and intermediate collections are sometimes found, but the correlation of colour, vestiture, and marginal curvature warrant tentative specific recognition. Weber (1972) separated *H. subglabra* from *H. atra* on the basis of grey to dark grey ascocarp and very fine excipular vestiture, as opposed to the black glabrous apothecium of *H. atra*. Both of these features are variable in others (e.g., *H. lacunosa*, *H. albella*, and *H. latispora*) and are insufficient to warrant specific recognition, in agreement with Häffner (1987).

Collections Examined: CANADA: Alberta: Minnie Lake near Glendon, Abbott 08 10 1983, ALTA 8265; Wagner Natural Area, Abbott (SA 1038, 1050, 1107) 08 25 & 09 4 1994, 08 19 1995, SA; Devonian Botanic Garden near Devon, Abbott 07 25 & 28 1987, 09 2 1988, 07 27 1989, ALTA 8266, 8297, 8310, SA 110. **Ontario**: Aubinadong River, Algoma District, Cain 08 2 1956, TRTC 35344. **USA**: **Montana**: Echo Lake, Flathead National Forest, Cummins 07 14 1928, MICH. **Michigan**: Reese's Bog, A.H. Smith 07 10 & 27 1963, UBC F3241, F3267.

Helvella compressa (Snyder) N.S. Weber, 1975, Beihefte Nova Hedwigia 51: 35.

≡*Paxina compressa* Snyder, 1936, Mycologia 28: 486.

Type Material: Holotype WTU, examined; isotype NY, examined.

Fig. 49.

Apothecium: 4-19 mm diam., 3-20 mm high, irregularly lobed, margin strongly inrolled initially, often remaining somewhat inrolled at maturity, free from stipe, hymenium when dry dark brown, smooth, excipular surface when dry cream to pale grey brown, densely pubescent to villose. **Stipe**: 5-50 x 1-6 mm, enlarged at base to nearly equal, typically tapered at apex, when dry cream to pale yellow brown, pubescent to villose, especially at apex, terete or fluted at base, internally solid or rarely hollow in large specimens. **Asci**: 280-349 x 15.2-22.0 μm, cylindrical, tapered to base, hyaline, pleurorhynchous. **Paraphyses**: 4.3-8.6 μm diam. at apex, clavate, enlarged gradually to apex, pale brown to brown in mass, contents finely granular. **Ascospores**: 19.7-23.8 x 11.4-14.8 μm, broadly ellipsoidal, smooth, with SEM finely rugose, uniguttulate, with large central globose to broadly ellipsoidal oil guttule.

Habitat: Solitary, gregarious, subcaespitose, or scattered and numerous on soil or litter, rarely with burnt woody debris, in coniferous or infrequently in mixed or deciduous woods. Associated trees: *Pseudotsuga menziesii, Abies grandis, Pinus ponderosa, Thuja plicata, Quercus garryana, Alnus rubra*, and *Acer* sp. Associated shrubs: *Symphoricarpos* sp. Fruiting from March 9 to December 25 in coastal WA. April to June collections are common.

Distribution: In coastal and montane regions in the western portion of the study area from AK, BC, WA, ID, and OR. Endemic to western North America, and known only west of the Rocky Mountains. This species is newly reported from AK, BC, ID, and OR. Known distribution extends south of the study area to California (Weber 1975). Map 22.

Notes: This species is closely related to *H. latispora* (q.v.) but is distinguished by geographic distribution, ascocarp pigmentation, and excipulum vestiture (see also notes under *H. latispora*). Both species apparently have a prolonged fruiting period, although vernal collections are typical.

Collections Examined: CANADA: British Columbia: Goldstream P.P., Vancouver Island, Ramsay 04 5 1978, UVIC; Mount Douglas Park, Victoria, Vancouver Island, Paden (JWP 583, 584, 1383) 04 5 & 7 1968, 03 20 1987, UVIC; Mount Douglas Park, Victoria, Vancouver Island, Egger (877, 955) 04 10 1982, 03 29 1983, DAOM 199815, 199816, 199793; University of Victoria campus, Vancouver Island, Paden (JWP 710, 743) 05 10 1969, 04 3 1970, UVIC; Roche Cove Park, East Sooke, Paden (JWP 1326) 04 26 1986, UVIC; Sooke road, Vancouver Island, Paden (JWP 1171) 05 11 1981, UVIC; near Saturna Beach, Saturna Island, Kroeger 05 16 1986, UBC F12511. **USA: Alaska**: Eklutna Lake north of Anchorage, Kempton 08 29 1972, 09 11 1973, WK 5901, 6057. **Washington**: Friday

Harbor, San Juan Island, Snyder (Stz 12223) 11 12 1960, WTU; Friday Harbor, San Juan Island, McCabe (Stz 19893) 11 20 1976, WTU; Friday Harbor, San Juan Island, Brough (56, 67) 04 21 & 05 5 1957, WTU; Friday Harbor, San Juan Island, Stuntz (Stz 2378, 12143, 12173, 12270, 12371) 10 30 & 11 5 & 12 25 1960, 06 4 1961; Friday Harbor, San Juan Island, Isaacs (Is 1711a, b) 05 19 & 20 1962, WTU; Friday Harbor, San Juan Island, SDL-B (Stz 21688) fall 1981, WTU; Lower Priest Point Park, Olympia, Mason & Mead (Brough 96) 03 9 1958, WTU; south of Olympia, Isaacs (Is 1754) 05 30 1962, WTU; Easton, Snyder 05 5 1934, NY (isotype), WTU (holotype); California Creek near Valley Ford, Cooke 06 8 1947, WSP; Bingen Mountain, Klickitat Co., Suksdorf 05 1 1899, WSP 27476, 27477; unknown, FHL fire trail, SDL-B 03 25 & 04 9 1977, WTU. **Idaho**: northeast of Robinson Lake, Latah Co., Koenigs 07 19 1964, WSP 55003. **Oregon**: Wilsonville, Ardrey (CA 1166) 04 20 1987, WTU; Mary's Peak road, Paden 03 26 1970, UVIC. **Exsiccata**: Vancouver Island Fungi, 499, Vancouver Island, BC, Canada, Macoun 04 13 1915, s.n. *Helvella elastica*, UBC F3256.

Helvella elastica Bulliard : Fries, 1823, Systema Mycologicum 2: 21.

≡*Helvella elastica* Bulliard, 1785, Herbier de la France, Plate 242.

≡*Leptopodia elastica* (Bulliard : Fries) Boudier, 1885, Bulletin de la Societé Mycologique de France 1: 99.

(additional synonyms see Dissing 1966b).

Type Material: Lectotype in Bulliard, 1785, Herbier de la France, Plate 242 Figures A, B, D-G (selected Dissing 1966b).

Fig. 5b.

Apothecium: 5-40 mm diam., 4-20 mm high (up to 45 x 40 mm fresh), irregularly lobed to bilobate and saddle-shaped or irregularly convex, sometimes slightly laterally compressed initially, margin reflexed from initial stages, may be appressed to stipe but typically remaining free, rarely fused to stipe, hymenium medium to dark brown or greyish brown fresh, rarely slightly mottled with paler patches, when dried dark brown to blackish brown, slightly undulate-rugose to smooth, excipular surface white to pallid greyish white or pale yellow brown when dried, glabrous. **Stipe**: 5-50 x 2-5 mm (up to 105 x 11 mm fresh), equal or enlarged at base, white to cream or pale yellow brown when dry, glabrous to finely pubescent or pubescent, terete or fluted especially at base, terete or slightly sulcate and internally hollow. **Asci**: 280 x 19 µm. **Paraphyses**: 5-7 µm diam. at apex, clavate, enlarged gradually to apex, pale brown, contents finely granular. **Ascospores**: 17.9-22 x 10.8-15 µm, broadly ellipsoidal, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary to gregarious on soil, litter, moss, or rarely rotted wood, in coniferous or mixed woods. Associated trees: *Picea glauca, Picea sitchensis, Pseudotsuga menziesii, Tsuga heterophylla, Pinus contorta, Pinus banksiana, Abies balsamea, Larix laricina, Thuja plicata, Populus tremuloides, Populus balsamifera, Betula papyrifera,* and *Betula occidentalis*. Associated shrubs: *Salix serissima, Salix bebbiana, Salix discolor, Alnus* sp., *Prunus pensylvanica, Viburnum edule, Shepherdia canadensis, Vaccinium vitis-idaea, Cornus canadensis,* and *Linnaea borealis*. Fruiting from June 5 in ID to December 25 in coastal WA.

Distribution: Widely distributed and common throughout boreal, montane, and coastal regions from AK, YT, BC, AB, SK, MB, WA, ID, MT, and WY. Also reported from OR by Larsen and Denison (1978). Distributed in eastern North America (Weber 1972; Groves and Hoare 1953; Anderson and Ickis 1921), Europe (Dissing 1966b; Häffner 1987), and Asia (Liu *et al.* 1985; Imai 1954; Kar and Pal 1970). Map 20.

Notes: This species is characterized by the apothecium, which is never inrolled and is reflexed from initial stages, glabrous excipulum, and hollow stipe. *Helvella elastica* is closest to *H. albella* (q.v.). The two species are similar in colour and habit, but distinguished by excipular vestiture and margin characteristics (see also notes under *H. albella*). *Helvella latispora* (q.v.) is also similar, but differs in its paler hymenium, pubescent excipulum at least in initial stages, and initially strongly inrolled margin.

Collections Examined: CANADA: Yukon: Yukon River southeast of Boundary, Ginns 07 19 1984, DAOM 195457; Campbell Highway, Ginns 08 4 1980, DAOM 195456. **British**

Columbia: Tetsa River P.P., Abbott (SA 221, 223, 225) 08 22 1989, SA; Fort Nelson, Szczawinski 07 27 1962, DAOM 14424; Mount Robson P.P., Abbott (SA 926) 08 29 1993, SA; south of Wells Gray P.P., Goward 09 8 1980, DAOM 186396; near Clearwater, Goward 09 10 1982, DAOM 191772; Adams River south of Adams Lake, Goward, 10 21 1982, DAOM 191779; Francis Park, Victoria, Vancouver Island, Melburn 11 1 1962, DAOM 109932; Victoria, Vancouver Island, Newcombe, K. **Alberta**: Shaw Lake east of Lac La Biche, Abbott (SA 102) 07 15 1989, SA; Musreau Lake south of Grande Prairie, Abbott (SA 246, 247, 253, 261) 08 26 1989, SA; Iosegun Lake east of Fox Creek, Abbott (SA 125) 08 6 1989, SA; William A. Switzer P.P., Abbott (SA 265, 270) 08 27 1989, SA; William A. Switzer P.P., Osis (SA 389, 390) 09 2 1990, SA; Wagner Natural Area, Abbott (SA 1041, 1046) 08 25 & 09 4 1994, SA, K; North Saskatchewan River valley, Edmonton, Zelmer 08 22 1995, ALTA; Devonian Botanic Garden near Devon, Abbott (SA 920, 1084) 07 27 1987, 08 25 1993, 08 9 1995, ALTA 8269, SA, K; Devonian Botanic Garden near Devon, Currah 08 19 1980, ALTA 8270; near Ponoka, Stewart 08 16 1962, ALTA 667; Fish Lake near Nordegg, Abbott (SA 281, 287, 288, 382, 399) 08 31 1989, 08 4 & 09 8 1990, SA. **Saskatchewan**: Candle Lake, Zalasky 08 30 1955, CFB WINFM 1289. **Manitoba**: Clear Lake, Bisby 08 17 1935, DAOM 206804. **Ontario**: Lake Temagami, Jackson 08 21 1930, TRTC 1780; Blue Lake, Brant Co., Cain 10 14 1956, WSP 45561. **Québec**: Richmond Gulf area, Huhtinen 08 30 1982, TUR 78713; Astray Lake, Schefferville, Huhtinen & Kosonen 08 12 1979, TUR 63423. **USA**: **Alaska**: Harding Lake near Fairbanks, Kempton 08 26 1965; Fox Springs near Fairbanks, Kempton 08 7 1970, WK 4620; Eklutna Lake north of Anchorage, Kempton 08 29 1961, WK 1580; Lower Skilak Lake, Kenai Peninsula, Kempton 09 27 1965, WK 1581; Bartlett River trail, Glacier Bay National Monument, Cooke 09 1 & 4 & 9 1979, 09 1 1981, WSP 64398, 67208, MU F34794, F36152; Haines, Kempton 09 21 1970, WK 4974; Auke Bay near Juneau, Kempton 09 13 1967, WK 1586. **Washington**: north of Mount Bonaparte and Lost Lake, east of Tonasket, Brazle, WSP 64709; Friday Harbor, San Juan Island, Stuntz (Stz 3602, 8997, 12270, 15271) 06 8 1948, 11 13 1954, 12 25 1960, 11 29 1968, WTU; Friday Harbor, San Juan Island, Isaacs (Is 2013) 11 11 1962, WTU; Friday Harbor, San Juan Island, McCabe (Stz 19893) 11 20 1976, WTU; Friday Harbor, San Juan Island, Tyler (Stz 12221) 11 12 1960, WTU; San Juan campground, Stevens Pass road, SDLB 09 26 1976, WTU; Seattle, Zeller (180), WTU; Isput Creek, Mount Rainier N.P., Williams (JWL 1228) 10 20 1971, WTU; Trout Lake-Cispus junction, van de Bogart (FVB 1015) 10 23 1971, WTU; Iron Butte, van de Bogart (FVB 3805) 10 31 1976, WTU; Iron Creek, van de Bogart (FVB 2882) 07 13 1974, WTU; unknown, Stuntz (Stz 982, Stz 15084) 10 26 1968, WTU. **Idaho**: Clearwater Canyon east of Lenore, Nez Perce Co., Cooke 06 5 1947, WSP 24506; Fall Creek at French Creek Grade, Idaho Co., Miller 09 4, 7 1964, WSP 53685, 53845, 54086. **Montana**: Echo Lake, Flathead National Forest, Cummins 07 20 & 30 1928, MICH. **Wyoming:** Turpin Meadow road, Ammirati (JFA 9546) 08 13 1987, WTU. **Michigan**: Pellston, Isaacs (Is 26a) 07 20 1957, WTU. **SWEDEN**: Uppsala, Fries, K. UNKNOWN: Coch 09 1872 Herbarium Berkeley, K; Toscana Bicchi autumn 1859, K; Petrak 08 1936, IMI 38460. **Exsiccata**: Fungi Suecici, Hejdeby parish, Gotland, Pettersson 10 11 1946, WSP 31527; Flora Hungarici Exsiccata, 208, Iglófüred, 08 1913, s.n. *Leptopodia elastica*, TRTC.

Helvella ephippium Léveillé, 1841, Annales des Sciences Naturelles Botanique, Ser. 2, 16: 240.

=*Helvella murina* (Boudier) Saccardo & Traverso, 1910, in Saccardo, Sylloge fungorum omnium hucusque cognitarum 19: 849. (*fide* Dissing 1966b). (additional synonyms see Dissing 1966b).

Type Material: not available (*fide* Dissing 1966b). Dissing (1966b) suggests that the illustration in Léveillé be chosen as lectotype. One authentic collection examined by Léveillé, discussed by Dissing (1966b) could perhaps be chosen as neotype.

Apothecium: 5-10 mm diam., 5-10 mm high, irregularly lobed to saddle-shaped, sometimes laterally compressed initially, margin strongly inrolled initially, remaining incurved at maturity, hymenium medium to dark brown fresh, when dried dark grey brown, smooth, excipular surface medium brown to grey brown, pubescent to villose. **Stipe**: 15 x 1.5-2 mm, equal, nearly white to pale grey brown, pubescent, terete, not fluted, internally solid. **Asci:** 150-280 x 17-19 µm, cylindrical, tapered to base, hyaline. **Paraphyses**: 3-7 µm diam. at apex, clavate, enlarged gradually to apex, brown, contents finely granular. **Ascospores**: 17-21 x 10.1-13 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary on soil or humus in deciduous, mixed, or coniferous woods. Associated trees: *Picea glauca, Abies balsamea, Populus balsamifera*, and *Populus tremuloides*. Associated shrubs: *Cornus stolonifera*. Fruiting from August 1 in MB to October 1 in AB.

Distribution: Rare in boreal regions of the study area. Known from AB and MB. Also in eastern North America (Weber 1972), Europe (Dissing 1966b; Häffner 1987), and Asia (Imai 1954). Map 23.

Notes: This species is close to *H. pezizoides* (q.v.) and *H. atra* (q.v.) which are distinguished by their black ascocarps, and *H. latispora* (q.v.) which lacks the villose excipulum. Also, *H. ephippium* lacks fluting on the slender stipe. *H. ephippium* is also similar to *H. chinensis* (q.v.) in the subgenus *Cupuliformae* which has the same colour and stature, but *H. chinensis* is typically cupulate, while *H. ephippium* has a more complex folded and lobed apothecium.

Collections Examined: CANADA: Alberta: Notikewin P.P., Abbott (SA 138) 08 7 1989, SA; Emily Murphy Park, Edmonton, Tsuneda 09 15 1976, ALTA 7446; Emily Murphy Park, Edmonton, Zelmer (SA 930) 10 1 1993, SA; North Saskatchewan River valley, Edmonton, Zelmer 08 24 1995, ALTA; Pearce Estate, Calgary, Danielson (RMD 1278) 09 14 1973, ALTA 8287. **Manitoba**: Victoria Beach, Bisby 08 1 1927, DAOM 154814. **NORWAY**: Ørdal, Kirkoy, Hvaler, Østfold, Kristiansen 07 22 & 10 24 1982, RK.

Helvella latispora Boudier, 1898, Bulletin de la Societé Mycologique de France 14: 16.

=*Helvella stevensii* Peck, 1904, Bulletin of the Torrey Botanical Club 31: 182. (holotype NYS, examined).

≡*Leptopodia stevensii* (Peck) Le Gal, 1937, Revue de Mycologie 2: 156.

=*Helvella connivens* Dissing & M. Lange, 1967, Mycologia 59: 351. (*fide* Weber 1972; Häffner 1987).

=*Leptopodia corbieri* Malençon, 1927, Bulletin de la Societé Mycologique de France 43: 95, Pl. 3 Fig. 7. (*fide* Dissing 1966b).

Type Material: Holotype PC, examined.

Fig. 5c.

Apothecium: 3-16 mm diam., 5-15 mm high, irregularly lobed to bilobate and saddle-shaped, margin inrolled initially, becoming reflexed at maturity, hymenium pale grey brown to medium brown fresh, when dried pale yellow brown to brown, smooth to slightly undulate-rugose, excipular surface cream to pallid grey brown, finely pubescent to pubescent. **Stipe**: 6-20 x 1-5 mm, equal or slightly enlarged to base, apex typically tapered, white, when dried cream to pallid greyish yellow brown, finely pubescent to pubescent, terete or shallowly fluted at base, internally solid. **Asci**: 290-330 x 13.3-15.6 µm. **Paraphyses**: 5.1-8.6 µm diam. at apex, clavate, enlarged gradually to apex, hyaline, contents finely granular. **Ascospores**: (16.5) 18.6-19.9 (20.8) x (10.9) 11.4-12.4 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Gregarious on soil or litter in deciduous, mixed, or coniferous woods. Associated trees: *Alnus rugosa*, *Populus* sp., and *Picea glauca*. Fruiting from June 27 in ID to August 29 in MB.

Distribution: Rare in boreal and montane regions from AB, MB, and ID. Distributed in eastern North America (Weber 1972 as *H. stevensii*) and Europe (Dissing 1966b; Häffner 1987). This species is newly reported from AB and MB. Larsen and Denison (1978) report it (as *H. stevensii* and *H. connivens*) from OR and WA, but these reports may refer to *H. compressa*. Map 22.

Notes: This species is closely related to *H. compressa* (q.v.) and the two are primarily distributed in eastern and western North America respectively. They can be easily separated by the villose excipular surface and darker hymenium of *H. compressa*. *Helvella latispora* is also close to *H. albella* (q.v.), but separable by colour. The apothecial margin of *H. latispora* is also more strongly inrolled over the hymenium in initial stages. The specimens from ID (see also Weber 1975) and AB are extreme western collections of *H. latispora*, and share the pale hymenium and finely pubescent excipulum typical of eastern collections. Häffner (1987) synonymizes *H. stevensii* with Boudier's (1898) older *H. latispora*, and type of material is similar. Dissing (1966a, b) retained *H. latispora* as distinct on the basis of the broad ascospores (13.5-18 μm in Dissing 1966b), but our measurements of spores in distilled water from the type specimen show a range from 11.8 to 14.0 μm in width.

Collections Examined: CANADA: Alberta: Fish Lake near Nordegg, Abbott (SA 374, 376) 08 3 1990, SA. **Manitoba**: Rolling River road, Riding Mountain N.P., Ginns & Hammersley 08 23 1979, DAOM 176223; near Bear Lakes, Riding Mountain N.P., Redhead 08 29 1979, DAOM 175852. **Ontario**: Lake Opinicon, Elliott & Groves 07 12 1961, TUR 38572, DAOM 87941; Nashville, Cain 10 2 1954, TRTC 30370; Nashville, Luck-Allen 09 30 1963, TRTC 43727. **USA: Idaho**: Twin Lakes, Kootenai Co., Weber (NSW 3653) 06 27 1972, MICH. **Michigan**: Detroit, Stevens 06 1903, NYS (holotype of *H. stevensii*); Pellston Hills west of Pellston, Shaffer 07 14 1964, UBC F951. **Iowa**: Amana, Martin & Brasfield 06 7 1938, ALTA 664, 665, 666. **NORWAY**: Østfold, Kråkerøy, Rød, Ekheim-parken, Kristiansen 07 28 1985, RK. **UNITED KINGDOM**: Kirk Lane, Priory, Yorkshire, Holland 09 13 1983, IMI 290669; Chevering Park, Kent, Reid 10 16 1982, K. **FRANCE**: France, Boudier Herbier Mycologique, PC (holotype).

Helvella pezizoides Afzelius : Fries, 1823, Systema Mycologicum 2: 20.

≡*Helvella pezizoides* Afzelius, 1783, Kongl. Vetensk. Akad. Nya Handl. 4: 308. (additional synonyms see Dissing 1966b).

Type Material: Lectotype in Afzelius, 1783, Kongl. Vetensk. Akad. Nya Handl. 4: 308, Plate 10 Figure 2 (selected Dissing 1966b).

Apothecium: 2.5-8 mm diam., 2-7 mm high, bilobate or irregularly lobed to irregularly cupulate or discoid, occasionally laterally compressed initially, margin strongly inrolled initially, remaining incurved at maturity, hymenium when dry black, smooth or rarely slightly undulate-rugose, excipular surface dark brown to dark grey brown, pubescent to villose. **Stipe**: 3-25 x 0.5-3 mm, enlarged slightly to base, apex tapered, when dry dark brown to dark grey brown or blackish brown, pubescent to villose, terete or fluted at base, internally solid. **Asci**: 100-315 x 14.1-18.6 μm. **Paraphyses**: 4-8.6 μm diam. at apex, terminal cell 40-60 μm long, clavate, enlarged gradually to abruptly at apex, brown to dark brown in mass, contents finely granular. **Ascospores**: 16.9-20.8 x 10.7-13.3 μm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary to gregarious on soil, humus, or rotted wood in woodland, bog or tundra habitats. Fruiting from July 27 in AK to August 16 in the NWT and AK.

Distribution: Rare in boreal, coastal, and arctic regions from AK, NWT, and AB. This species is newly reported for the NWT and AK. Also in eastern North America (Weber 1972), southern North America (Dissing 1966b), Europe (Dissing 1966b), and Asia (Liu *et al.* 1985; Tewari *et al.* 1971). The specimens from Jamaica (and likely the ones described as *H. atra* by Denison 1963 from Costa Rica) are somewhat intermediate between *H. pezizoides* and *H. atra*, but are assigned to *H. pezizoides* based on the densely pubescent excipular surface and incurved apothecial margin. Map 23.

Notes: This species is very close to *H. atra* (q.v.), but differs in its strongly involute apothecial margin, densely pubescent to villose excipular surface, and strong brown pigmentation of the excipulum and stipe (see also notes under *H. atra*). In addition, *H. pezizoides* is occasionally irregularly cupulate to discoid, while *H. atra* is regularly bilobate to irregularly lobed. Collections of *H. pezizoides* from Alaska were referred to *H. atra* by Kempton and Wells (1970). *Helvella ephippium* (q.v.) is also related, but is easily separated by the paler ascocarp.

Collections Examined: CANADA: Northwest Territories: mouth of Thelon River, Baker Lake, Ohenoja 08 16 1974, DAOM 155302; Williamson Lake, Rankin Inlet, Ohenoja 08 10 1971, DAOM 155313. **Alberta**: Kinsmen ravine, Edmonton, Elisens 08 1977, ALTA 7606. **Québec**: Richmond Gulf area, Huhtinen 08 31 1982, TUR 78796. **USA: Alaska**: near Nome, Seward Peninsula, Kempton 08 12 1967, WK 1533; butte area near Palmer, Kempton 07 27 & 08 16 1961, WK 1534, 1535. **Michigan**: Tahquamenon Falls State Park, Brough (513) 08 9 1963, UBC F3266.

JAMAICA: Blue Mountain, Dennis 12 20 1949, K. **NORWAY**: Østfold, Borge, Torp, Kristiansen 07 6 1984, 08 1 1987, RK 87.21. **FRANCE**: Paris, Reid 08 10 1989, K. **Exsiccata**: Karsten Fungi Fenniae, 446, På ängsbackar vid Mustiala, Karsten 08 1866, s.n. *H. atra*, K.

Extralimital Species

Helvella leucopus Persoon, 1823, Mycologica Europaea 1: 213.

=*Helvella monachella* auct.; non *H. monachella* Scopoli : Fries (=*Gyromitra* sp.)(*fide* Dissing 1966b).

(additional synonyms see Dissing 1966b).

Type Material: Lectotype (selected Dissing 1966b) L, examined.

Distribution: Known from Europe (Dissing 1966b; Moravec 1980), north Africa (Dissing 1966b) and Asia (Liu *et al.* 1985). No specimens referable to this taxon were found during this investigation. Dissing (1966b) reported it from ID. Weber (1975) could not confirm its presence in ID, but describes a specimen with some similarities. These are the only reports, and its occurrence in North America is questionable.

Notes: This species is close to *H. elastica* (q.v.) and *H. albella* (q.v.), but has a darker hymenium, larger ascocarp, robust stipe, and more complex lobed apothecium. Häffner (1987) and Dissing (1966b) synonymize the older *H. spadicea* Schaeffer, but no type material is known for this taxon, without which we could not support adoption of a forgotten name for this well known species. This taxon is referred to *Helvella monachella* by many authors, but the original concept of *H. monachella* (Fries 1823) is based on a *Gyromitra* species (Dissing 1966b).

Collections Examined: NETHERLANDS: Herbarium Persoon, L 8945-2 (lectotype); Ijselmeerpolders, Flevoland, De Abbert, Bas 05 14 1977, TRTC. **Exsiccata**: Herbarium Mycologicum Romanicum, 667, Mutenia, district Ilfov, Rumania, Savulescu & Alexandri 05 8 1933, s.n. *Helvella monachella*, IMI 29629, TRTC.

Helvella Subgenus *Helvella*

≡*Helvella* section *Helvella*

≡*Helvella* section *Crispae* Dissing, 1966, Dansk Botanisk Arkiv 25: 85.

=*Helvella* section *Lacunosae* Dissing, 1966, Dansk Botanisk Arkiv 25: 98.

Type Species: *Helvella crispa* Scopoli : Fries, 1823, Systema Mycologicum 2: 13.

Ascocarp: apothecium irregularly lobed to irregularly convex, margin inrolled initially or reflexed, free or fused to stipe; hymenium white, brown, grey, or black, undulate-rugose; excipular surface pubescent to glabrous; stipe distinct, strongly ribbed, usually lacunose, internally chambered. **Asci:** pleurorhynchous. **Ascospores:** broadly ellipsoidal, hyaline, smooth with light microscope, with SEM finely rugose, uniguttulate.

Notes: The type subgenus *Helvella* includes species treated in sections *Crispae* and *Lacunosae* of Dissing (1966b). The broad concept employed here includes species with a prominent, strongly ribbed stipe posessing lacunae and a chambered internal structure. The apothecium is highly lobed and irregularly folded. The differences in excipular pubescence, apothecial marginal curvature, and fusion with the stipe, used to separate the sections of Dissing (1966b) are not considered taxonomically significant at the subgenus level (although they may show relationships among individual species within the subgenera). These characters show greater or lesser prominence in different species, and form a progression of morphological intermediates between the extremes (see also discussion under taxonomic significance of macroscopic characters). The subgenus *Helvella* corresponds closely to the genus *Helvella* in its most restricted sense (e.g., Boudier 1885, 1907; Breitenbach and Kränzlin 1981).

Key to species of *Helvella* subgenus *Helvella*

1. Apothecial margin inrolled initially, remaining free from stipe at maturity............ 2
1'. Apothecial margin reflexed initially, becoming fused with stipe at maturity.......... 3
    2. Hymenium white to cream; excipular surface pubescent................***H. crispa***
    2'. Hymenium medium to dark brown; excipular surface densely pubescent to villose..***H. maculata***
3. Ascocarp dark grey brown to black..***H. lacunosa***
3'. Ascocarp white..***H. lactea***

Helvella crispa Scopoli : Fries, 1823, Systema Mycologicum 2: 14.

≡*Phallus crispus* Scopoli, 1772, Flora carniolica 2: 475.

=*Helvella leucophaea* Persoon, 1799, Observationes mycologicae 2: 19. (holotype K, examined).

=*Helvella mitra* Linnaeus, 1753, Species Plantarum 2: 1180. (*fide* Dissing 1966b). (additional synonyms see Dissing 1966b).

Type Material: Lectotype (selected Dissing 1966b) in Micheli, 1729, Nova Plantarum Genera 204, Tab. 86 Fig. 7.

Figs. 6a,b, 45.

Apothecium: 5-50 mm diam., 5-50 mm high (up to 70 x 55 mm fresh), irregularly lobed, occasionally bilobate, margin inrolled over hymenium initially, becoming reflexed at maturity, free from stipe, hymenium white to cream fresh, often drying tan to yellowish brown, rugose, excipular surface cream to beige, typically slightly darker than hymenium, finely pubescent to pubescent, sometimes with few small ribs extending onto basal third of excipular surface from stipe. **Stipe:** 6-130 x 2-35 mm, equal or enlarged at base, white to cream or pallid grey brown, highly ribbed, often lacunose, finely pubescent to pubescent, internally chambered. **Asci:** 225 x 14.4-17 µm. **Paraphyses:** 5.8-8 µm diam. at apex, apical cell 14-37 µm long, clavate, enlarged gradually or abruptly at apex, hyaline, contents finely granular. **Ascospores:** 16.5-20.6 x 10-13 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary, gregarious, or scattered on soil and litter in deciduous or mixed woods. Associated trees: *Populus tremuloides, Populus balsamifera, Betula papyrifera, Betula occidentalis, Alnus tenuifolia, Arbutus menziesii, Picea glauca, Picea sitchensis, Pinus banksiana, Pinus contorta, Abies grandis*, and *Pseudotsuga menziesii*. Associated shrubs: *Salix bebbiana, Salix discolor, Corylus cornuta, Alnus crispa, Prunus pensylvanica, Amelanchier alnifolia, Shepherdia canadensis, Viburnum edule, Lonicera involucrata*, and *Rosa* sp. Fruiting from July 11 in AB to November 15 in WA.

Distribution: Widely distributed in boreal, coastal, and montane regions from AK, YT, NWT, BC, AB, SK, MB, WA, ID, and OR. This is a very common species in boreal and aspen parkland regions in the study area. Also found in eastern North America (Weber 1972), Europe (Dissing 1966b, Häffner 1987), and Asia (Liu *et al.* 1985; Imai 1954). Map 9.

Notes: This distinctive species is most closely related to *H. maculata* (q.v.) and *H. fusca* (q.v.) which share the initially inrolled, free margin and pubescent excipular surface and stipe. Distinction is made on the basis of ascocarp coloration, degree of vestiture, and habitat. *Helvella crispa* superficially resembles *H. lactea* (q.v.) which is also white to cream, but can be separated by its reflexed margin fused to stipe and glabrous excipular surface.

Collections Examined: **CANADA: Yukon:** Dempster Highway near Dawson, Ginns 08 8 1980, DAOM 195471; 3 km northeast of Mayo, Calder 08 1 1949, DAOM 25986. **Northwest Territories:** Hay River, Green 08 30 1984, UVIC. **British Columbia:** Tetsa River P.P., Abbott (SA 218, 219, 222, 226) 08 22 1989, SA; Moberly Lake P.P., Schalkwyk 08 15 1977, DAOM 175734; Prince George, Brough (651) 09 20 1968, UBC F3244; 50 km south of Quesnel, Calder, Savile & Ferguson 09 4 1954, DAOM 45603; Wells Gray P.P., Abbott (SA 923) 08 28 1993, SA; Spahats Creek P.P., Abbott (SA 924) 08 28 1993, SA; San Josef Bay, Vancouver Island, (SDLB 617) 08 28

1975, WTU. **Alberta:** north of Meander River, Abbott (SA 144) 08 8 1989, SA; Notikewin P.P., Abbott (SA 129, 136) 08 7 1989, SA; McKay River south of Fort McMurray, Dumais 07 27 1968, ALTA 663; Fawcett Lake, Abbott 09 3 1988, ALTA 8318, 8319, 8320; Musreau Lake, Abbott (SA 245, 249, 255, 256, 257) 08 26 1989, SA; Sheep Creek north of Grande Cache, Abbott (SA 263, 264) 08 26 1989, SA; Long Lake, States 08 13 1967, ALTA 662; Sandy Lake, Schalkwyk 07 11 1975, ALTA 7907, DAOM 175714; east of Redwater, Schalkwyk 09 5 1978, ALTA 7901; William A. Switzer P.P., Abbott (SA 269) 08 27 1989, SA; William A. Switzer P.P., Osis (SA 386) 09 2 1990, SA; near Onoway, Osis (SA 880) 08 8 1993, SA; Muir Lake area, Bozniak & Wheelock 09 14 1965, ALTA 661; Wagner Natural Area, Abbott (SA 1039, 1052, 1111) 08 25 & 09 4 1994, 08 19 1995, SA, K; Forest Reserve, Edmonton, Kennedy 09 15 1976, ALTA 7292; Emily Murphy Park, Edmonton, Tsuneda 08 1976, ALTA 7359; Devonian Botanic Garden near Devon, Currah 09 4 1977, 07 1979, 08 31 1980, 07 21 1982, ALTA 7534, 7957, 8268, 8275; Devonian Botanic Garden near Devon, Abbott (SA 108, 716, 764, 895, 919, 928, 1083, 1086) 09 3 1987, 07 25 1989, 08 15 & 09 3 1992, 08 16 & 25 & 09 11 1993, 08 9 & 08 11 1995, ALTA 8276, SA, K; Devonian Botanic Garden near Devon, Richardson 09 1 1988, ALTA 8311; 10 km south of Leduc, Abbott 08 8 1981, ALTA 8283; near Cynthia, Osis & Gibson 08 14 1988, ALTA 8309; near Breton, Osis & Gibson 08 1 & 20 1988, ALTA 8300, 8303; Fish Lake near Nordegg, Abbott (SA 282, 375, 400) 08 31 1989, 08 3 & 09 8 1990, SA. **Saskatchewan:** Turtle Lake near Turtleford, Zelmer 08 1994 (not accessioned). **Manitoba:** Gilbert Plains, Provincial Horticulturalist 09 1954, DAOM 45142; Victoria Beach, Bisby 09 11 & 12 & 19 1926, 08 8 1928, 09 7 1931, DAOM 206802, 206801, 206800, TRTC; Victoria Beach, Reid 09 8 1968, WIN; Pinawa, Bisby 09 2 1935, DAOM 206803; Manitoba Agricultural College, Winnipeg, Bisby & Gordon 08 5 1928, DAOM 154794; Winnipeg, Frankton 08 28 1956, DAOM 54284; Melbourne, Oliver 09 7 1969; Darwin, Sutton 09 10 1968, CFB WINFM 10304. **Ontario:** Apsley, Cain 09 26 1956, TRTC 32970; Angus, Cain 10 10 1954, WSP 43051. **Québec:** Lac La Pêche, Gatineau, Cain 09 22 1973, TRTC 48034. **USA: Alaska:** Eklutna Lake north of Anchorage, Kempton 08 24 1963, 1971, WK 1575, 5200; butte area north of Anchorage, Kempton 08 8 1960, 09 25 1982, WK 1574, 6429. **Washington:** Seward Park, Seattle, Stuntz (Brough 48) 11 15 1956, WTU; Olympic Hot Springs, Olympic N.P., Smith (17192) 09 22 1941, MICH; Money Creek, Litke 09 1 1981, WTU 21467. **Idaho:** near Coolin, Priest Lake, Bonner Co., Harrison (6355) 10 6 1966, MICH; Capoose Creek, Seven Devils Mountain, Idaho Co., Smith (46550) 08 23 1954, MICH; Seven Devils Range, Hawker 08 10 1962, K. **Oregon:** Bellview-Tolman Creek area near Ashland, Isaacs (Is 1456) 11 11 1961, WTU. **Minnesota:** Lake Co., Paim 08 20 1956, TRTC. **Ohio:** Antioch Forest, Yellow Springs, Cooke 10 20 1962, WSP 55743. **New Mexico**: east of Santa Fe, Simms 09 19 1965, WSP 57198. **SWEDEN:** Uppsala Botanical Garden, Melderis 09 28 1946, K. **UNITED KINGDOM:** The Staits, North Hampshire, 10 23 1960, IMI 83683. **NETHERLANDS:** between Bergen and Schoorl, Maas Geesteranus 10 2 1965, TRTC 14777; unknown, Persoon, K (holotype of *Helvella leucophaea*). **Exsiccata:** Fungi Suecici, Västmanland, Sala, Sweden, Morander (1348) 07 24 1948, s.n. *Helvella crispa*, WSP 31528; Flora Hungarica Exsiccata, Sectio Botanica Musei Nationalis Hungarici, Cent III, Fungi 29, 209, Iglófüred, Filarszky 08 1913, s.n. *Helvella crispa*, TRTC; M.C. Cooke, Fungi Britannici Exsiccati, Editio Secunda, 541, Durncore, United Kingdom, Cooke, s.n. *Helvella crispa*, IMI 29260; E. Bartholomew, Fungi Columbiani, 3329, London, Ontario, Canada, Dearness 10 1908, 1909, 1910, s.n. *Helvella crispa*, WSP 3107.

Helvella lactea Boudier, 1907, Histoire et Classification des Discomycètes d'Europe p. 36.

Type Material: Holotype PC, examined.

Apothecium: 4-40 mm diam., 6-35 mm high, irregularly lobed, often bilobate, margin reflexed and fused to stipe, rarely free from stipe in immature specimens, hymenium white fresh, when dried bright yellow brown to medium brown, lacking grey pigmentation, undulate-rugose to nearly smooth, excipular surface white, when dry cream to pallid yellow, glabrous or rarely very finely pubescent, ribs virtually absent or extending onto basal half of excipular surface. **Stipe:** 9-95 x 2-20 mm, equal, tapering, or enlarged to base, white, when dry cream to bright yellow, very finely pubescent, strongly ribbed, lacunose, internally chambered, occasionally sulcate and solid in small specimens. **Asci:** 287-325 x 13.2-20.1 µm. **Paraphyses:** 3.9-7.0 µm diam. at apex, clavate, enlarged gradually to apex, hyaline, contents finely granular. **Ascospores:** 15.6-22.1 x 10.7-13.9 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary to gregarious on soil or litter in coniferous or mixed woods. Associated trees: *Abies* sp. Fruiting from July (exact date unknown) in MB to December 25 in WA.

Distribution: Infrequent in boreal and coastal regions from MB and WA. This species is newly reported from western North America. Collections from coastal WA significantly extend its range to the west in North America, while collections from MB represent the most northerly collections described from North America. The disjunct population is locally common in WA. Also known from eastern North America (Dissing 1966a; Dissing and Lange 1967), Europe (Dissing 1966b; Calonge and Arroyo 1990), and Asia (Liu and Cao 1988). Map 9.

Notes: Although similar in colour, *H. crispa* (q.v.) is distinct in its cream to pale brown pubescent excipular surface and inrolled free apothecial margin. *Helvella lactea* is distinguished from the closely related *H. lacunosa* (q.v.) by the lack of grey pigmentation. Even pale forms of *H. lacunosa* (e.g., SA 211, Smith 75904 MICH) are grey in fresh and dry specimens, while *H. lactea* is entirely white when fresh and yellow, especially on the stipe, when dried. *Helvella lactea* has a much more restricted distribution than *H. lacunosa*. Häffner (1987, 1991) considers this species a pigmentless form of *H. lacunosa*. One collection (WTU Stz 12122) was mixed with *H. lacunosa*. Close association between these two species may support recognizing *H. lactea* as a variety or form.

Collections Examined: **CANADA: Manitoba:** Indian Bay, Shoal Lake, Tan 07 1966, WIN. **Ontario:** Bear Island, Lake Timagami, Jackson 08 21 1937, TRTC 11140; Algonquin P.P., Jackson 09 15 1939, TRTC 18492. **USA: Washington:** Friday Harbor, San Juan Island, Stuntz (Stz 12122) 10 30 1960, WTU; Robinswood Park, Bellevue, Martin (FVB 1702) 11 16 1972, WTU; Tacoma Prairies, Snyder (50) 11 10 1934, WTU; Yelm, Stuntz (Stz 4870) 10 17 1948, WTU; Rainier, (Stz 6116) 11 5 1950, WTU; Rainier woods, Stuntz (Stz 4921), 11 13 1948, WTU; Humbug Mountain trail, Ardrey (901) 12 25 1985, WTU. **SWEDEN:** Botanic Garden, Uppsala, Hylander 07 25 & 08 2 1939, K. **FRANCE:** Meaux, Dumeé 06 1902, PC (holotype). **SPAIN:** Cadalonia, Reid 11 2 1985, K.

Helvella lacunosa Afzelius : Fries, 1823, Systema Mycologicum 2: 15.

≡*Helvella lacunosa* Afzelius, 1783, Kongl. Vetensk. Akad. Nya Handl. 4:303.

=*Helvella mitra* Persoon, 1797, Commentario de Fungis Clavaeformibus sistens specierum hus usque notarum descriptiones cum differentiis specificis, nec no autorum synonomis p. 61. (type K, examined)(later homonym); non *Helvella mitra* Linnaeus (=*H. crispa*).

=*Helvella subcostata* Cooke, 1879, Mycographia, seu icones fungorum Fig. 169. (holotype K, examined).

=*Helvella sulcata* Afzelius: Fries, 1823, Systema Mycologicum 2: 15. (*fide* Dissing 1966b).

(additional synonyms see Dissing 1966b).

Type Material: not available (*fide* Dissing 1966b).

Fig. 8.

Apothecium: 5-47 mm diam., 4-60 mm high (up to 70 mm diam. fresh), irregularly lobed and reflexed, rarely trilobate to bilobate or irregularly saddle-shaped, margin reflexed even when immature, margin fused to stipe or rarely free, hymenium black to dark grey or dark brown (fresh and dried), rarely pale grey brown or somewhat mottled with darkly and lightly pigmented regions, undulate-rugose, excipular surface pallid grey to dark grey brown, glabrous, ribs absent or extending to near marginal regions of excipular surface. **Stipe:** 20-140 x 3-35 mm, equal or enlarged at base, rarely tapered slightly to base, dark grey brown or pallid in part especially if submerged in substratum, glabrous, highly ribbed, lacunose, internally chambered, rarely sulcate and solid especially at apex. **Asci:** 238-268 x 13.1-17 µm. **Paraphyses:** 3.9-(10) µm diam. at apex, terminal cell 124-165 µm long, clavate, enlarged gradually to abruptly at apex, brown, contents finely granular. **Ascospores:** 14.5-(20) x 10-13 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary to gregarious, subcaespitose, or scattered on soil or litter, rarely on rotted or burnt wood, in coniferous or mixed woods. Associated trees: *Picea glauca, Picea mariana, Picea sitchensis, Pinus contorta, Pinus banksiana, Pinus ponderosa, Pseudotsuga menziesii, Abies balsamea, Abies grandis, Larix occidentalis, Thuja plicata, Populus tremuloides, Populus balsamifera, Betula papyrifera, Betula occidentalis, Alnus* sp., and *Acer macrophyllum*. Associated shrubs: *Salix discolor, Salix bebbiana, Salix planifolia, Salix myrtillifolia, Salix alaxensis, Salix reticulata, Alnus crispa, Betula pumila, Ledum groenlandicum, Shepherdia canadensis, Juniperus communis, Arctostaphylos viscida, Cornus stolonifera, Symphoricarpos* sp., and *Rosa* sp. Fruiting from June in MB to April 15 in coastal southern BC. November through April fruitings are known only from southern portions of the study area in BC, WA, ID, and OR. June to August collections are known only from AK, YT, NWT, BC, AB, SK, and MB.

Distribution: Widely distributed in boreal, montane, coastal, and arctic regions from AK, YT, NWT, BC, AB, SK, MB, WA, ID, and OR. Also distributed in eastern North America (Weber 1972), Europe (Dissing 1966b), and Asia (Liu *et al.* 1985; Imai 1954; Korf and Zhuang 1991). Map 11.

Notes: The species is characterized by the darkly pigmented ascocarp, reflexed apothecial margin, and glabrous excipular surface and comprises *H. lacunosa sensu lato* (*sensu* Dissing 1966b, Abbott and Currah 1988, Calonge and Arroyo 1990). We could not support recognition of taxa, such as *H. sulcata sensu* Weber 1972 or Benedix 1972, as either a species or variety. Closely related species include *H. lactea* (q.v.) which differs in colour, *H. palustris* (q.v.), and *H. phlebophora* Patouillard & Doass. which has smaller ascocarps, convex apothecia with the margin free and reflexed, and a solid stipe. Häffner (1987, 1991) suggests that *H. phlebophora*, *H. palustris*, and *H. lactea* are best treated as varieties of *H. lacunosa*. Occasionally, ascocarps approaching the overall morphology of *H. phlebophora*, (as described in Dissing 1966b; Breitenbach and Kränzlin 1984 edition only) appear with typical specimens of *H. lacunosa* (e.g., ALTA 8314). *Helvella palustris* was synonymized with *H. lacunosa* by Dissing (1966b), but was accepted by Weber (1972) and Harmaja (1977b). After examination of the holotype and collections from Michigan, *H. palustris* is tentatively accepted as distinct from *H. lacunosa* by the small apothecium, often with free margin, slender stipe with few or no lacunae and little anastomosis between ribs. Some collections (e.g., TUR 78771) are intermediate between *H. lacunosa* and *H. palustris*. Many collections of *H. palustris* are from bogs or stream banks and associated with bryophytes.

Collections Examined: **CANADA: Yukon:** Watson Lake, Abbott (SA 179, 180, 185, 192, 193, 194) 08 14 & 20 1989, SA. **Northwest Territories**: Striae Hill, Axel Heiberg Island, Beschel 08 10 1962, DAOM 91441; Baker Lake, Ohenoja 08 1962, DAOM 155310; Hay River, Green 09 5 1982, UVIC. **British Columbia:** Muncho Lake P.P., Abbott (SA 211, 212, 213) 08 21 1989, SA; Tetsa River P.P., Abbott (SA 220, 227, 230) 08 22 1989, SA; Mount Robson P.P., Abbott (SA 925) 08 29 1993, SA; near Valemount, Wohlebbe 09 20 1987, ALTA 8366; Mahood Lake, Person 10 10 1977, UBC F3282; 10 km north of Clearwater, Goward 09 12 1982, DAOM 191776; Shuswap Lake near Scotch Creek, Goward 10 2 1982, DAOM 191777; Revelstoke, Funk 10 10 1962, DAOM 14578; Brandywine Falls near Whistler, Bandoni 10 21 1977, UBC F3281; Brandywine Falls P.P., Mackinnon 10 4 1980, UBC F587; Cheekye, Bandoni 09 26, UBC F3274; Procter, Linton 10 18 1977, UVIC; Cottonwood Lake near Nelson, Harrison (6030A) 07 6 1966, MICH; Lions Bay, Perrin 10 8 1968, UBC F3278; Lynne Valley Park, North Vancouver, Kroeger 11 18 1981; UBC F10244; Lynne Valley Park, North Vancouver, Bandoni 10 4 1959, UBC F3276; Lynne Canyon, Vancouver, Pantidou 10 3 1962, DAOM 92265; UBC endowment lands, Vancouver, Waugh 10 29 1958, UBC F3272; UBC endowment lands, Vancouver, Brough (661) 11 24 1972, UBC F1345, F3279; UBC endowment lands, Bandoni 12 8 1962, UBC F3277; UBC campus, Brough (626) 11 3 1967, UBC F3273; UBC campus, Redhead 11 18 1969, UBC F1344; UBC campus, Bandoni 10 27 1962, 04 15 1988, DAOM 91102, 199922; Little Qualicum Falls P.P., Vancouver Island, Lee 10 30 1979, UBC M047; Long Beach, Pacific Rim N.P., Brigham 11 8 1980, Wood 11 25 1974, UVIC; Spectacle Lake, Vancouver Island, Pantidou 10 19 1962, DAOM 92263; Robert's Bay, Vancouver Island, Macoun 10 21 1913, UBC F3292; Langford, Vancouver Island, Hinders 11 11 1943, DAVFP 21936; Francis Park near Victoria, Vancouver Island, Egger (857) 12 27 1981, DAOM 199857; Mount Douglas Park, Victoria, Vancouver Island, Egger 09 29 1983, DAOM 199768; Crescent Beach, Krajina 10 10 1970, UBC F3280; Saltspring Island, Paden 10 13 1969, UVIC; Saturna Island, Pillsbury 11 13 1960, UBC F3275; Cortez Island, Ring 11 11 1986, UVIC. **Alberta:** Fawcett Lake, Abbott 09 3 1988, ALTA 8314, 8315; Iosegun Lake, Abbott (SA 111, 112, 118) 08 4 & 5 1989, SA; Musreau Lake, Abbott (SA 248) 08 26 1989, SA; William A. Switzer P.P., Abbott (SA 267, 271) 08 27 1989, SA; William A. Switzer P.P., Osis (SA 388) 09 2 1990, SA; Wagner Natural Area, Abbott (SA 1037, 1051, 1108) 08 25 & 09 4 1994, 08 19 1995, SA; Forest Reserve, Edmonton, Kennedy 09 15 1976, ALTA 7291; Devonian Botanic Garden near Devon, Abbott (SA 1082, 1130, 1140) 08 24 1987, 08 9 & 24 & 09 12 1995, ALTA 8271, SA, K; Alder Flats, Zelmer (SA 929) 09 25 1993, SA; Riley Lake, Jasper N.P., Abbott (SA 1054) 09 7 1994, SA; Wabasso, Jasper N.P., Zelmer (SA 927) 07 17 1993, SA; Athabasca River valley 3 km west of Sunwapta Falls, Jasper N.P., Abbott (SA 372) 08 2 1990, SA. **Saskatchewan:** Turtle Lake near Turtleford, Zelmer 08 1994 (not accessioned). **Manitoba:** Churchill, Huhtinen 08 19 1981, TUR 78771; Victoria Beach, Bisby 07 29 1928, DAOM 206811; Indian Bay, Shoal Lake, Tan 06 1966, WIN. **Ontario:** Angus, Cain 10 10 1954, WSP 43248. **USA: Alaska:** Eagle summit 175 km north of Fairbanks, Kempton 08 19 1971, WK 5348; Fairbanks, Kempton 08 7 1970, WK 4619; Nome on Seward Peninsula, Kempton 08 25 1970, WK 4793; Nancy Lake, Susitna valley, Kempton 08 15 1968, 09 7 1985, WK 1570, 6470; Eklutna Lake north of Anchorage, Kempton 08 24 1971, WK 5189; Anchorage, Kempton 08 30 1966, 08 31 1971, 09 5 1986, WK 1565, 5395, 6508; Glacier Bay National Monument, Cooke 09 7 & 8 & 10 1979, 08 31 & 09 5 & 9 1981, WSP 65708, 64400, 64439, 64797, 64854, 67209, 66865, 66866, DAOM 176194, 176213, MU F34857, F36149; near Haines, Kempton 09 20 1970, 09 16 1971, WK 4953, 5596; near Juneau, Kempton 09 13 1967. **Washington:** Nooksack Falls, Mount Baker area, Whatcom Co., Symons 11 11 1965, UBC F3283; San Juan Island, Waugh 11 19 1966, UBC F3284; Friday Harbor, San Juan Island, (Stz 12122, 12222) 10 30 & 11 12 1960, WTU; Whidbey Island, Stuntz (Stz 13874, 14513, 14552) 09 8 1966, 11 5 1967, 11 14 1967, WTU; Sandy Hook, Whidbey Island, (Stz 13854) 09 8 1966, WTU; Langley, Whidbey Island, (Stz 14538) 09 14 1962, WTU; east of Springdale, Cooke 09 27 1947, WSP 24512; Barnes Creek trail, Olympic N.P., Clallam Co., Cooke 10 26 1950, WSP 25049; near Staircase, Olympic N.P., McKenny, 10 24 1962, UBC F3287; Bremerton, Flett 11 26 1930, WSP AS29265; Marysville, Grant 11 1931, MU F14172; Mercer Island near Seattle, Parker (Herbarium Young Naturalists Society 200) 12 1893, WTU; Seward Park, Seattle, (Stz 11583) 10 19 1959, WTU; Seattle, Zeller (57) 1911, WTU; Seattle, Snyder (29) fall, WTU; Watermain Woods, Redmond, SDLB 11 2 1980, WTU; California Creek near Valley Ford, Cooke 11 8 1947, WSP 24513; north of Copalis, Clallam Co., Williams (JWL 999) 10 11 1970, WTU; Burnis Lake near Olympia, Williams (JWL 1719) 11 3 1973, WTU; Olympia, Snyder 12 4 1933, WTU; south of Spanaway, Simms 11 12 1966, WSP 57197; Tahoma Vista, Mount Rainier N.P., van de Bogart (FVB 2245) 10 28 1973, WTU; south of Cispus turnoff, van de Bogart (FVB 1036) 10 23 1971, WTU; Bear Creek, Grouse Flats, Garfield Co., Shaw 11 1 1954, WSP 41533; Medicine Creek drainage, Asotin Co., Shaw 11 2 1959, WSP 47623; Bingen, Suksdorf 01 24 1900, WSP 27480; Falcon Valley, Klickitat Co., Suksdorf 11 1 1901, WSP 27479; Lee Forest near Maltby, Brough (12) 10 16 1956, WTU; Lee Forest near Maltby, Cohen (Stz 6982) 11 16 1952, WTU; Millersylvania State Park, Spur (Stz 16987) 11 13 1971, WTU; Fort Lewis, Stuntz 11 1 1934, WTU; Troublesome Creek, (Stz 14954) 09 26 1968, WTU; Browns Lake, van de Bogart (FVB 2451, 2570) 11 3 1973, WTU; unknown, Browns 11 13 1971, WTU 906, 11 16 1974, WTU 3295, Isaacs (Is 1362) 03 21 1961, Ardery (1290), Williams (JWL 33), WTU. **Idaho:** Nordman, Shaw 10 16 1954, WSP 41576; Priest Lake, Rogers 10 27 1963, WSP 56475; Priest River Experimental Forest, Slipp 10 28 1940, WSP 49792; Hayden Lake, Kootenai Co., White 10 1959, WSP 47630; Moscow Mountain, Ward 09 28 1947, WSP 30113; Moscow Mountains, Miller 09 14 1964, WSP 54048, 54484; Laird Park, Latah Co., Miller 10 17 1962, WSP 52704; Clearwater Canyon east of Lenore, Cooke 11 30 1946, WSP 24511; Rackliff Ridge trail along Selway River, Nez Perce National Forest, Cooke 10 26 1946, 11 1 1947, WSP 24510, DAOM 26783; Rackliff Creek, Idaho Co., Cooke 10 22 1949, WSP 30112; Ticks Creek road, van de Bogart (FVB 3729) 09 9 1976, WTU. **Oregon:** Coos Co. Forest, Ardrey (538), WTU; west of Ruch, Isaacs (Is 558, 560) 01 26 1958, WTU; Bellview-Tolman Creek area, Isaacs (Is 1455) 11 11 1961, WTU; McReady Springs, Paden 04 20 1972, UVIC. **California:** Lake Siskiyou, Bangsberg 04 25 1980, WSP 66107; Bear Springs, Mount Shasta, Cooke 10 10 1958, WSP 55868; Mineral, Cooke 09 2 & 3 1977, 09 1978, 10 6 1981, WSP 63395, 63396, 60991, 67210; Jonesville, Copeland 09 30 1938, WSP 31526; San Francisco Bay region, Morse spring 1934, UBC F3296; Walnut Creek, Contra Costa Co., Baltzo 01 8 1984, UBC F13113. **Michigan**: Tahquamenon, Bas 08 12 1963, UBC F3285; Pine Barrens, Topinabee, Smith (75904) 08 10 1968, MICH. **SVALBARD:** Endahlen, Currah 08 17 1988, ALTA 8305; Sverdrupbyen, Currah 08 16 1988, ALTA 8313. **UNITED KINGDOM:** Twyford Forest, Lines, Roberts 09 9 1988, IMI 310080; Andover, Hampshire, Herbarium Berkeley 1879, K (holotype of *Helvella subcostata*). **BELGIUM:** Demoulin (CBS 404.74), UAMH 6474 (living culture) **SPAIN**: Cuenca, Calonge & Arroyo 05 28 1985, K. **NETHERLANDS:** Persoon, K (type of *Helvella mitra*). **Exsiccata**: Mycobiota of North America, 246, Rackliff Creek, Nez Perce National Forest, Idaho, USA, Cooke 11 16 1946, s.n. *Helvella lacunosa*, WSP 21369; Ellis and Everhardt's

Fungi Columbiani, 1931, Stockton, Kansas, USA, Bartholomew 06 3 1903, s.n. *Helvella lacunosa*, WSP 3108; Pacific Slope Fungi, 256, Stanford University, Santa Clara Co., California, USA, Banker 02 18 1902, s.n. *Helvella lacunosa*, WSP 23883; California Fungi, 316, Trinidad, Humbolt Co., California, USA, Parks 11 1931, s.n. *Elvella mitra*, WSP 35290, WTU, TRTC.

Helvella maculata N.S. Weber, 1975, Beihefte Nova Hedwigia 51: 27.

Type Material: Holotype MICH, examined.

Fig. 7.

Apothecium: 10-45 mm diam., 5-26 mm high (up to 40 x 30 mm fresh), irregularly lobed, margin strongly inrolled over hymenium initially, free from stipe, hymenium light to dark brown to grey brown (fresh and dried), sometimes mottled with patches of paler pigmentation, undulate-rugose, excipular surface white or cream to pallid grey, densely pubescent to villose, ribs absent or extending onto basal third of excipular surface. **Stipe:** 10-120 x 3-30 mm, enlarged at base, white, often with localized regions of brown to grey brown pigmentation, finely pubescent, highly ribbed, lacunose, internally chambered. **Asci:** 268-300 x 15.2-19 µm. **Paraphyses:** 5.6-9 µm diam. at apex, clavate, enlarged gradually to abruptly at apex, brown, finely granular. **Ascospores:** 18-23.4 x 11-14 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate, with large, central, broadly ellipsoidal to subglobose oil guttule.

Habitat: Solitary, gregarious, or scattered on soil or duff in coniferous or mixed woods. Associated trees: *Picea glauca, Picea sitchensis, Pseudotsuga menziesii, Tsuga heterophylla, Populus tremuloides, Populus balsamifera*. Associated shrubs: *Salix* sp., *Rosa* sp., *Viburnum edule, Cornus stolonifera,* and *Alnus* sp. Fruiting from August 1 in AB to November 30 in coastal WA. Collections from January to March in coastal BC, WA and OR and May in BC are considered unusual for this typically autumnal species. August and September collections are usual for AK, AB and MB, while October and November collections are typical of WA, ID, and BC.

Distribution: Widely distributed in montane, coastal, and boreal regions, but abundant only in the west from AK, BC, AB, MB, WA, ID, and OR. The range is significantly expanded eastward to MB and north to AK. Distributed only in western North America (Weber 1975) and China (Cao 1988; Liu and Cao 1988). Map 10.

Notes: This species is closely related to *H. crispa* (q.v.) and *H. fusca* (q.v.)(see notes under *H. crispa*). The darkly pigmented apothecium has lead to confusion with *H. lacunosa* (q.v.), which has a reflexed apothecium margin even in immature fruiting bodies, and the margin fused to the stipe. *Helvella maculata* was originally described as having consistently mottled apothecia (Weber 1975). This feature is found in Chinese material (Cao pers. comm.; Cao and Liu 1990), but in fresh and dried material examined in this study, many were uniform in colour. Cao (pers. comm.) has suggested that specimens with uniform pigmentation may be referable to another taxon, but there are no correlating features supporting this. Mottled hymenia are sometimes found in *H. lacunosa* (q.v.), *H. albella* (q.v.), and *H. elastica* (q.v.), and may be due in part to the degree of exposure of the hymenium at the surface of the substratum. Darkly pigmented regions on the white stipe are sometimes observed in *H. maculata*.

Collections Examined: CANADA: British Columbia: Brandywine Falls near Whistler, Bandoni 10 27 1977, UBC F3281; Yale, Macoun 05 17 1889, DAOM 44703; Sidney, Vancouver Island, Macoun 1912, UBC F3297; Mount Douglas Park, Victoria, Vancouver Island, Paden 11 11 1988, UVIC; University of Victoria campus, Vancouver Island, Paden (JWP 1378) 01 5 1987, UVIC; University of Victoria campus, Vancouver Island, Fogarty 11 18 1988, UVIC; ravine near Houlihan Way, Gordon Head, Goodacre 11 8 1976, UVIC. **Alberta:** William A. Switzer P.P., Osis (SA 387) 09 2 1990, SA; west-end ravine, Edmonton, Osis & Gibson 08 1 1988, ALTA 8301; near Breton, Osis & Gibson 08 20 1988, ALTA 8304; Fish Lake near Nordegg, Abbott (SA 380) 08 3 1990, SA; Bragg Creek P.P., Danielson (RMD 2343) 09 18 1976, ALTA 8292; Fish Creek P.P., Calgary, Danielson (RMD 359) 08 20 1972, DAOM 143866; Kananaskis, Vellinga (SA 295) 08 1989, SA, L. **Manitoba:** Clear Lake, Bisby 09 23 1933, 08 17 1935, DAOM 206812, 206808. **USA: Alaska:** Eklutna Lake north of Anchorage, Kempton 08 11 & 24 1963, WK 1576, 1577; butte area north of

Anchorage, Kempton 09 22 1965, WK 1578; mile 40 Haines cutoff road, Kempton 09 20 1970, WK 4962. **Washington:** Friday Harbor, San Juan Island, Isaacs (Is 2019) 11 11 1962, WTU; Friday Harbor, San Juan Island, Stuntz (Stz 8996, 11594, 12087, 15306, 15869, 17044) 11 13 1954, 11 1 1959, 10 16 1960, 11 30 1968, 11 29 1969, 11 26 1971, WTU; Friday Harbor, San Juan Island, Williams (JWL 564, 1307) 11 9 1969, 11 7 1971, WTU; Friday Harbor , San Juan Island, van de Bogart (FVB 3864) 11 1976, WTU; San Juan Island, Bandoni 11 20 1966, UBC F3286; Mutiny Bay, Island Co., van de Bogart (FVB 3362) 03 2 1975, WTU; east of Duvall, van de Bogart (Stz 14460) 11 5 1967, WTU; Olympia, Snyder 10 8 1933, WTU; unknown, van de Bogart (FVB 3687) 11 15 1975, (Stz 12121, 13810, 15221) 10 28 1966, 11 10 1968, WTU. **Idaho:** Hoodoo Mountain, Bonner Co., Smith (NJS 2124) 10 5 1968, MICH (holotype); Jerome Creek, Latah Co., Paden & Tylutki 10 11 1964, WSP 56274; Moscow Mountain, Latah Co., Milne 10 18 1965, TRTC. **Oregon:** near Gold Hill, (Stz 10929) 03 27 1959, WTU.

Extralimital Species

Helvella fusca Gillet, 1879, Champignons de France. Les Discomycètes, p. 9.

Type Material: Neotype selected here: S, Italy, Al Deserto, Bresadola 05 21 1898, examined.

Distribution: Restricted to Europe (Dissing 1966b).

Notes: This species is similar to *H. maculata* (q.v.) in colour, but differs in excipular pubescence and habitat. Vernal and autumnal collections are known for both species. This species is reported from Alaska and Oregon (Kempton and Wells 1970; Larsen and Denison 1978), but no specimens were encountered during this investigation and reports are likely based on *H. maculata*. Although there is no authentic material of Gillet (Dissing 1966b), the modern concept of *H. fusca* is primarily based on the description and excellent specimens of Bresadola preserved in S. The 'Al Deserto 05 21 1898' (illustrated in Dissing 1966b) is chosen as neotype.

Collections Examined: **ITALY:** Al Deserto, Bresadola 05 21 1898, S (neotype); bei Trient, Bresadola 06 1898, S; prope Trento, Bresadola 05 18 1903, S; Gocciadora, Bresadola 10 1901, S.

Helvella palustris Peck, 1880, Annual Report New York State Museum 33: 31.

=*Helvella philonotis* Dissing, 1964, Botanisk Tidsskrift 60: 117. (*fide* Weber 1972).

Type Material: Holotype NYS, examined.

Distribution: Known from eastern North America (Weber 1972; Huhtinen 1982) and Europe (Harmaja 1977b, Dissing 1966b, as *H. philonotis*; Hallgrimsson 1968, as *H. philonotis*).

Notes: This species is closely related to *H. lacunosa* (q.v.), but is separated by its small size, slender solid stipe with parallel ribs which show little anastomosis and no lacunae, and the discoid to convex apothecium which remains free from the stipe. Häffner (1987) considers it a variety of *H. lacunosa*, but the correlation of many morphological features warrants tentative retention of specific status. No specimens from the study region have been assigned to this taxon, but several collections of *H. lacunosa* (e.g., DAOM 91441, TUR 78771) are intermediate. Reports from northern Manitoba (Huhtinen 1984; Hutchison *et al.* 1988) are based on TUR 78771, which contains some specimens with chambered and lacunose stipes typical of *H. lacunosa*. Other collections of *H. lacunosa* contain immature fruiting bodies resembling *H. palustris*. The collection from Norway shows more similarities to the description of *H. philonotis* (Dissing 1966b) than to other collections of *H. palustris* examined here.

Collections Examined: **CANADA: Québec:** Astray Lake, Schefferville, Huhtinen & Kosonen 08 12 1979, TUR 63425. **USA: Michigan:** Tahquamenon Falls State Park, Brough UBC F3295; UMBS, Emmet Co., Rogerson 08 6 1964, UBC F3293; south of Rose City, Ogemaw Co., A.H. Smith 07 16 1963, UBC F3294. **New York:** Manlius Center, Peck 08, NYS (holotype); Southbay near Whitehall, Burnham 08 20 1908, NYS. **NORWAY:** south of Kongsvoll, Oppland, Kristiansen 08 8 1991, RK.

Helvella Subgenus *Leucomelaenae* (Dissing) S.P. Abbott *comb. nov.*

≡*Helvella* section *Leucomelaenae* Dissing, 1966, Dansk Botanisk Arkiv 25: 36.
=*Helvella* section *Acetabulum* Dissing, 1966, Dansk Botanisk Arkiv 25: 49.
=*Helvella* section *Solitariae* Häffner, 1987, Beihefte zur Zeitschrift für Mykologie 7: 46.

Type Species: *Helvella leucomelaena* (Persoon) Nannfeldt, 1941, in Lundell and Nannfeldt, Fungi Exsiccati Suecici Praesidium Upsaliensis Fasciculata 19-21: 21, no. 952.

Ascocarp: cupulate to irregularly cupulate, subsessile to short stipitate; apothecium margin incurved or reflexed; hymenium smooth or sparingly rugose, shades of brown and grey; excipular surface pubescent to villose, ribs absent or extending to marginal region; stipe present as fluted base or distinct and prominently ribbed, solid or chambered, pubescent. **Asci:** bases aporhynchous to pleurorhynchous. **Ascospores:** broadly ellipsoidal to ellipsoidal, hyaline, smooth, surface with SEM finely rugose to nearly smooth, uniguttulate, with large, central, globose to broadly ellipsoidal oil guttule.

Notes: Subgenus *Leucomelaenae* contains indistinctly to distinctly stipitate species with prominently ribbed stipe and cupulate to reflexed apothecia. The subgenus comprises the sections *Leucomelaenae* and *Acetabulum* of Dissing (1966b) and section *Solitariae* of Häffner (1987), and closely corresponds to the genus *Acetabula* (*sensu* Boudier 1907).

Key to species of *Helvella* subgenus *Leucomelaenae*

1. Ascus base simple (aporhynchous)..2
1'. Ascus base forked (pleurorhynchous).. 3
    2. Ascospores 18-24 µm long; setoid paraphyses absent.........***H. leucomelaena***
    2'. Ascospores 23-28 µm long; setoid paraphyses present........***H. crassitunicata***
3. Distribution in arctic and alpine tundra regions..4
3'. Distribution in boreal and montane forest regions..5
    4. Hymenium red brown; stipe indistinct; excipular surface lacking ribs or indistinctly ribbed over basal portion.........................***H. aestivalis***
    4'. Hymenium brown; stipe distinct; excipular surface prominently ribbed over basal half..***H. verruculosa***
5. Ascospores very broadly ellipsoidal to subglobose (12.5-16 µm diam.).............. 6
5'. Ascospores ellipsoidal to broadly ellipsoidal (10-13.5 µm long)...................... 7
    6. Ascocarps small to medium (4-22 mm diam. dried); hymenium medium to dark grey brown; excipular surface densely pubescent to villose...***H. unicolor***
    6'. Ascocarps large (50-90 mm diam. dried); hymenium light to medium brown; excipular surface pubescent.....................................***H. robusta***
7. Ribs on excipular surface extending to marginal area, branched and anastomosed.. 8
7'. Ribs on excipular surface, if present, extending only slightly onto basal portion, simple and unbranched.. 9
    8. Ribs sharp-edged; excipular surface medium brown to yellow brown; ascospores 16-20 x 11-13.5 µm....................................***H. acetabulum***
    8'. Ribs blunt-edged; excipular surface medium to light grey brown, lacking yellow coloration; ascospores 14.5-20 x 9.5-12.5 µm......***H. costifera***
9. Stipe medium to pale brown, with conspicuous, dark pubescence; ribs extending onto basal half of excipular surface.....................***H. hyperborea***
9'. Stipe white to grey brown, with hyaline pubescence; ribs absent from excipular surface or extend only onto basal region....................***H. solitaria***

Helvella acetabulum (Linnaeus : Fries) Quélet, 1886, Enchiridion Fungorum, p. 275.

≡*Peziza acetabulum* Linnaeus, 1753, Species Plantarum 2: 1181.

≡*Peziza acetabulum* Linnaeus : Fries, 1823, Systema mycologicum 2: 44.

≡*Paxina acetabulum* (Linnaeus : Fries) Kuntze, 1891, Revisio generum plantarum 2: 864.

(additional synonyms see Dissing 1966b).

Type Material: Lectotype in Valliant, 1727, Botanicon Parisienne 57, Plate 13, Figure 1 (*fide* Dissing 1966b).

Apothecium: 10-80 mm diam., 5-20 mm high, deeply cupulate, margin expanding to slightly reflexed in age, hymenium medium to dark brown (fresh and dried), smooth, excipular surface brown near margin, yellow brown to white at base, pubescent to densely pubescent, prominently ribbed, with sharp, branching and anastomosing ribs extending to marginal region. **Stipe**: 3-45 x 2-30 mm, equal or tapered to base, white to light yellow brown, pubescent, highly ribbed, rarely lacunose, ribs sharp or rarely blunt, branched and anastomosed, internally chambered. **Asci**: 260-330 x 16-18 µm, pleurorhynchous. **Paraphyses:** 4-6 µm diam. at apex, clavate to nearly equal, enlarged gradually to apex, pale brown, contents finely granular. **Ascospores**: 16-20 x 11-13.7 µm, broadly ellipsoidal, hyaline, smooth, with SEM surface finely rugose, uniguttulate.

Habitat: Solitary to gregarious on soil or litter in coniferous, mixed or deciduous woods. Associated trees: *Populus tremuloides, Populus balsamifera, Arbutus menziesii, Quercus garryana, Alnus* sp., *Thuja plicata, Picea glauca* and *Pseudotsuga menziesii*. Associated shrubs: *Cornus stolonifera* and *Amelanchier alnifolia*. Fruiting from March 21 in OR to July 15 in BC.

Distribution: Widely distributed, although infrequent in boreal, montane and coastal regions from BC, AB, MB, WA, ID, OR, and WY. Also in eastern North America (Weber 1972), Europe (Dissing 1966b; Häffner 1987), and Asia (Liu *et al.* 1985). Map 13.

Notes: This species is most closely related to *H. costifera* (q.v.), and perhaps represents a single variable species. They are distinguished by ascocarp colour, ribbing of stipe and excipular surface, and fruiting period. *Helvella unicolor* (q.v.) is distinguished on ascospore morphology and less prominent ribbing of stipe and excipular surface. *Helvella verruculosa* (q.v.) differs in its smaller ascocarp size, stronger pubescence, less prominent stipe and ribbing of excipular surface, and habitat (see also notes under species mentioned above). The lack of extant holotype material seriously impedes characterization of this species, and distinction from similar taxa (especially *H. costifera*) is uncertain based on the lectotype illustration.

Collections Examined: CANADA: British Columbia: Vancouver, Waugh 07 15 1951, DAOM 27436; Bamberton P.P., Vancouver Island, Paden 06 7 1974, 05 6 1987, UVIC; Victoria, Vancouver Island, Robertson 04 14 1973, UVIC; Winter Cove, Saturna Island, Kroeger 04 2 1984, UBC F979. **Alberta:** William A. Switzer P.P., Osis (SA 418) 07 5 1990, SA; Devonian Botanic Garden near Devon, Currah 06 25 1979, ALTA 7958; North Saskatchewan River valley, Devon, Yurkiw & Abbott (SA 1159) 07 3 1996, SA; west of Millet, Kennedy 06 30 1964, ALTA 626; Bow Valley P.P., Danielson (RMD 2046) 07 1 1976. **Manitoba**: Manitoba Agricultural College, Winnipeg, Bisby 07 2 & 10 1932, DAOM 206814; Manitoba Agricultural College, Winnipeg, Bisby & Conners 07 14 1927, DAOM 183375. **Ontario:** Queen's Biological Station, Lake Opinicon, Kendrick 06 9 1963, TUR 38458, DAOM 91836; Lake Simcoe District, Taylor 06 16 1961, WIN. **USA: Washington**: Seattle, Greene (Snyder 123) 04 1929, WTU; Mercer Island east of Seattle, Ziegler (Stz 9369) 04 24 1941, WTU; Tacoma prairies, Snyder 05 15 1935, WTU; Bingen Mountain, Suksdorf 05 1 1899, WSP 27646, 27647; unknown, (Stz 7771) 07 8 1953, (Stz 1009, 18408), WTU. **Idaho**: Priest River Experimental Forest, Slipp 07 4 1941, WSP 50463. **Oregon**: near Goldhill, (Stz 10898) 03 27 1959, WTU; near Central Point, Isaacs (Is 1352) 03 21 1961, WTU; Antelope Creek road near Camp White, Isaacs (Is 518) 03 31 1957, WTU. **Wyoming**: Wyoming, van de Bogart, WTU. **UNITED KINGDOM**: Earlswood, Warwickshire, England, Ellis 05 6 1979, IMI 253044; Esher Common, Surrey, England, Spooner 05 25 1980, K. **NETHERLANDS**: Herbarium Persoon, L 8945-3. **FRANCE**: Corsica, Reid 06 3 1965, K. **SCANDINAVIA**: Öland, Böda parish, road to Bränslegardarna, Schöldström 05 31

1967, K. **Exsiccata**: North American Discomycetes, 1181, Ithaca, New York, USA, Durand 06 3 1901, s.n. *Acetabula vulgaris*, WSP 23744; Ellis and Everhardt's Fungi Columbiani, 1801, Stockton, Kansas, USA, Bartholomew 06 3 1903, s.n. *Acetabula vulgaris*, TRTC; Petrak, Mycotheca generalis, 204, Comit. Györ, Bönyretalap, Hungary, Nagy 05 1928, s.n. *Acetabula vulgaris*, WSP AS18071.

Helvella aestivalis (R. Heim & Remy) Dissing & Raitviir, 1974, Eesti NSV Teaduste Akadeemia Toimetised, Bioloogia 23(2): 105.

≡*Acetabula aestivalis* R. Heim & Remy, 1925, in Heim, Bulletin de la Societé Mycologique de France 41: 460, plate XXIX Figures 10-12.

Type Material: not available (*fide* Dissing and Raitviir 1974).

Fig. 23.

Apothecium: 3-26 mm diam., 1-17 mm high, deeply cupulate, margin inrolled initially, margin often splitting at maturity, rarely split to form a one sided lobe, rarely laterally compressed when immature, hymenium dark red brown to blackish red brown fresh, when dried blackish red brown, smooth, excipular surface dark brown at margin, pale orange/yellow brown at base, densely pubescent, occasionally with dense white marginal pubescence, ribs absent or extending onto basal two thirds of excipular surface. **Stipe**: virtually lacking to indistinct, 1-8 x 1-6 mm, tapered to base, white to pallid yellow/orange brown, pubescent, shallowly ribbed or fluted, sulcate and internally solid or with few chambers. **Asci**: 250-300 x 17-19 µm, pleurorhynchous. **Paraphyses**: 6.0-8.0 µm diam. at apex, clavate, enlarged abruptly at apex, brown to dark brown in mass, contents finely granular. **Ascospores**: (18.0) 20.1-22.7 (25.0) x (12.1) 12.8-15.4 (16.6) µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary to gregarious or scattered and numerous on soil or humus. Associated shrubs: *Salix* sp., *Cassiope* sp., *Andromeda* sp., and *Dryas* sp. Fruiting from July 17 in YT to August 15 in NWT.

Distribution: Widely distributed in arctic and alpine tundra regions in northern portions of the study area from YT and NWT. This species is newly reported from YT and extends the known range considerably to the west in North America. Circumpolar in North America, Europe (Dissing 1983, 1985; Schumacher and Mohn Jenssen 1992), and Asia (Dissing and Raitviir 1974). A global distribution map is provided in Dissing (1985). Map 14.

Notes: This species resembles *H. verruculosa* (q.v.). Both have northern distributions, are subsessile to short stipitate, and share a densely pubescent excipular surface with ribs often extending from stipe onto the basal portion. The two can be separated by ascocarp colour and spore size. *Helvella verruculosa* also tends to have more pronounced stipe and ribbing. Dissing (1983) reported the ascal bases as aporhynchous, but pleurorhynchous bases with croziers were observed in this study (Fig. 23) in both North American and European material. This feature is perhaps variable and lends support to the merging of sections *Leucomelaenae* and *Acetabulum sensu* Dissing (1966b). *Helvella leucomelaena* can be distinguished by the lack of reddish pigmentation, finely pubescent excipular surface, and spore size and shape. The only other species in the genus with a red brown ascocarp is *H. silvicola* (q.v.) in the subgenus *Silvicolae*.

Collections Examined: CANADA: Yukon: mountain west of Blackstone River, Ginns (18384) 07 17 1984, DAOM 195288. **Northwest Territories**: Hazen camp, Lake Hazen, Ellesmere Island N.P., Richards (77) 07 25 94, ALTA; west side Blister Hill, Ellesmere Island N.P. Richards (78) 07 4 94, ALTA; Alexandra Fjord, Ellesmere Island, Dissing & Raitviir (EI84.48, EI84.15, 84.16, EI84.25, EI84.35, EI84.40, EI84.47, EI84.59, EI84.76, EI84.84) 1984, C; Sverdrup Pass, Ellesmere Island, Cohen (LK84.41) 1984, C; Axel Heiberg Island, Beschel 07 29 1960, DAOM 75774; Axel Heiberg Island, Kuc 08 8 1967, DAOM 124703, 124707; east of Repulse Bay, Ohenoja 08 4 1974, OULU; Coal Harbor, Southampton Island, Savile 08 15 1959, DAOM 67075; Longstaff Bluff, Baffin Island, Parmelee & Seaborn 08 9 1967, DAOM 117582, 117583. **SVALBARD**: near Loven Glacier, Currah 08 12 1988, ALTA 8306; Loven Glacier, Currah 08 12 1988, ALTA 8307.

Helvella costifera Nannfeldt, 1953, in Lundell & Nannfeldt, Fungi Exsiccati Suecici Praesidium Upsaliensis Fasciculata 41-42: 37, No. 2061. (*nomen novum*).

≡*Peziza costata* Fries, 1851, Acta Regiae Societatis Scientiarum Uppsala Ser. 3 Vol. 1: 120. (illegitimate, later homonym)(holotype UPS, examined; isotype K, examined); non *Phallus costatus* Batsch, 1789, Elenchus Fungorum 129. (=*H. lacunosa*); non *Helvella costata* Schweinitz : Fries, 1823, Systema mycologicum 2: 19. (=*H. acetabulum*).

=*Helvella griseoalba* N.S. Weber, 1972, The Michigan Botanist 11: 162. (holotype MICH, examined).

(additional synonyms see Dissing 1966b).

Type Material: Holotype UPS, examined; isotype K, examined. (s.n. *Peziza costata*).

Fig. 3e.

Apothecium: 16-42 mm diam., 10-20 mm high, deeply cupulate, margin slightly inrolled initially, expanding at maturity, sometimes laterally compressed initially, hymenium medium to dark grey brown (fresh and dried), smooth to slightly undulate-rugose, excipular surface medium to pale grey brown, often white near base, finely to densely pubescent, ribbed, ribs white to cream, branching and anastomosing, blunt and rounded, extending to marginal region. **Stipe**: 8-20 x 8-10 mm, tapering to base or nearly equal, white to cream, finely pubescent, strongly ribbed, sometimes sparingly lacunose, ribs blunt, branched and anastomosed, internally chambered. **Asci**: 313-381 x 13.3-17.1 µm, pleurorhynchous. **Paraphyses**: 3.6-6.2 µm diam. at apex, terminal cell 13.3 µm long, clavate, enlarged gradually to apex, pale brown, brown in mass, contents finely granular. **Ascospores**: 14.4-19.7 x 9.6-12.4 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary to gregarious on soil in coniferous or mixed woods. Associated trees: *Populus tremuloides, Populus balsamifera, Betula papyrifera, Alnus* sp., *Picea glauca,* and *Pseudotsuga menziesii*. Fruiting from June 4 in coastal WA to August 24 in AK.

Distribution: Infrequent in boreal, montane, and coastal regions from AK, YT, AB, WA, and ID. This species is newly reported for AB. Also distributed in eastern North America (Weber 1972; Pomerleau 1980; as *H. griseoalba*), Europe (Dissing 1966b; Häffner 1987; Harmaja 1979a; Benedix 1965 as *Acetabula costifera*), and Asia (Dissing and Raitviir 1974; Cao *et al.* 1990). Map 14.

Notes: This species is often difficult to distinguish from *H. acetabulum* (q.v.). The two species have been separated on the basis of colour, ribbing, and fruiting time (Dissing 1966b; Harmaja 1977b, 1979a). *Helvella costifera* is greyer and the excipulum is not yellow brown. Specimens of *H. costifera* from Norway (RK) are typical except for a strong brown pigmentation (see also Dissing 1966b). The ribs of *H. costifera* are blunt and often more widely spaced than in *H. acetabulum*, but rare specimens otherwise typical of *H. acetabulum* with blunt ribs have been examined. *Helvella costifera* also fruits later (Dissing 1966b), but the collections referred to this taxon from North America overlap with later collections of *H. acetabulum*. The two taxa are tentatively retained, but more correlating features are required. *Helvella unicolor* (q.v.), *H. hyperborea* (q.v.), and *H. robusta* (q.v.) are also close and are distinguishable by characters discussed in the notes under those taxa.

Helvella griseoalba was described by Weber (1972) as distinct from *H. costifera* (which was not recognized from North America) on the basis of pale grey hymenium and lack of pigmentation in the ectal excipulum. Although Häffner (1987) verified the differences in excipulum pigmentation pattern in the type specimens, he questioned the usefulness of this character in specific delimitation. Our observations support Häffners concept of *H. costifera*.

Collections Examined: CANADA: Yukon Territory: Kluane Lake, Ahti (23071) 1967, H. **Alberta**: Shaw Lake near Lac La Biche, Abbott (SA 100) 07 15 1989, SA; 10 km south of

Leduc, Abbott 07 8 1979, ALTA 8264. **USA: Alaska**: Eklutna Lake north of Anchorage, Kempton 08 11 & 24 1963, 07 13 1966, 08 24 1971, WK 1536, 1537, 4013, 5202. **Washington**: Friday Harbor, San Juan Island, Stuntz (Stz 12380) 06 4 1961, WTU. **Idaho**: Rackliff Creek, Idaho Co., Cooke 07 6 1947, WSP 30103. **Michigan**: Grapevine Point, Douglas Lake, Cheboygan Co., Smith (NJS 982) 06 10 1968, MICH (holotype of *H. griseoalba*). **NORWAY**: near Bodo, Nordland, Johnson 07 1 1983, RK. **SWEDEN**: Uppsala Botanic Garden, Fries, UPS (holotype of *Peziza costata*), K (isotype). **Exsiccata**: Fungi Exsiccati Suecici Praesertim Upsalienses, 2061, Uppsala, Sweden, Nannfeldt (9956) 07 9 1948, s.n. *Helvella costifera*, S, K.

Helvella crassitunicata N.S. Weber, 1975, Beihefte Nova Hedwigia 51: 27.

Type Material: Holotype MICH, examined.

Fig. 52.

Apothecium: 4-50 mm diam., 3-33 mm high (up to 100 x 60 mm fresh), deeply cupulate, margin inrolled initially, expanding to shallowly cupulate or somewhat reflexed at maturity, hymenium medium to dark brown fresh, when dried dark brown to blackish brown, smooth to slightly undulate-rugose, excipular surface medium to dark brown, sometimes paler at basal region, pubescent to densely pubescent, ribs extending onto basal half of excipular surface (rarely extending only slightly onto excipulum). **Stipe**: 2-20 x 2-13 mm (up to 50 x 40 mm fresh), flaring and merging with apothecium, medium brown to pallid (especially at base), finely pubescent to pubescent, ribs indistinct to prominent, rounded, widely separated, may be bifurcate branched, but with no anastomosis between ribs, sulcate and internally solid. **Asci**: 350-400 x 17-20 µm, aporhynchous. **Paraphyses**: 5.4-8.8 µm diam. at apex, dimorphic, most thin-walled, terminal cell in some becoming elongated and thick-walled, clavate, expanding gradually to apex, often slightly irregular, terminal cell of thin-walled paraphyses 67-94 µm long, terminal cell of thick-walled paraphyses 235-300 µm long, pale brown to brown, contents finely granular, walls of thick-walled paraphyses pigmented. **Ascospores**: 22.7-27.6 x 12.6-14.6 µm, broadly ellipsoidal or ellipsoidal to subcylindrical, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Single, gregarious, or subcaespitose on soil under conifers. Associated trees: *Picea* sp., *Tsuga mertensiana, Pseudotsuga menziesii*, and *Thuja plicata.* Fruiting from May 20 in WA to October 13 in WA.

Distribution: Endemic to the interior and coastal mountains of northwestern North America, but rare, from AK, BC, and WA. Not known outside the study area. This species is newly reported from BC, and its occurrence in AK (Weber 1975) is confirmed. Map 16.

Notes: This species is unique in the family in its thick-walled paraphyses, and has the largest ascospores in the genus. Harmaja (1977b) discusses the usefulness of the length of the terminal cell of the paraphyses. Although this character is of limited value for some taxa, the thick-walled apical cell of the paraphyses of *H. crassitunicata* are the longest in the genus. The apical cell of the more numerous thin-walled paraphyses is much shorter and within the usual range for the genus. The thick-walled paraphyses of *H. crassitunicata* are similar to the setae of *Rhizina undulata* (q.v.). Both are thin-walled at the apex, pigmented, and aseptate. Setae of *Rhizina* are longer and arise below the hymenium. The aporhynchous ascal base and gross morphology suggest an affinity to *H. leucomelaena* (q.v.). *Helvella crassitunicata* can be distinguished by ascocarp colour, stronger pubescence of the excipular surface and stipe, and more pronounced ribbing of stipe and excipular surface. *Helvella pocillum* Harmaja (not examined) is reported to have very large ascospores similar to *H. crassitunicata*, but lacks thick-walled paraphyses (Harmaja 1976a). Specimens reported by Kempton and Wells (1970) as *H. leucomelaena* are referable to this taxon as suspected by Weber (1975).

Collections Examined: **CANADA: British Columbia**: Mount Abbott near Marian Lake, Glacier N.P., Shoemaker 08 6 1963, DAOM 109231; Trail to Glacier crest, Glacier N.P., Shoemaker 08 4 1963, DAOM 109227, 109230; trail to Great Glacier, Glacier N.P., Shoemaker 08 1 1963, DAOM 109228, 109229; Diamond Head, Garibaldi P.P., Abbott (SA 1029) 08 18 1994, SA; Cypress Bowl near Squamish, Abbott (SA 1028) 08 18 1994, SA. **USA: Alaska**: Turnagain Pass, Seward Highway, Kempton 07 21 1970, 08 27 1970, WK 4517, 4518, 4809. **Washington**: Bogachiel Peak, Olympic N.P., Smith (2745) 09 27 1935, MICH; Pierce Co., A.H. Smith, MICH (holotype); base of Carbon Glacier, Mount Rainier N.P., Tschudy (Snyder 103) 05 20 1934, WTU; Mount Rainier N.P., Smith (29746, 30598, 40077, 40875, 40916) 08 2 & 25 1948, 09 20 & 10 12 & 13 1952, MICH; Green Lake, Rainier, (Stz 7604), WTU; Iron Butte, van de Bogart (FVB 3794), WTU; Buck Creek area, van de Bogart (FVB 1915) 07 16 1973, WTU; unknown, 08 2 1948, WTU 3803.

Helvella hyperborea Harmaja, 1978, Karstenia 18: 57.

Type Material: Holotype H, examined.

Apothecium: 10-18 mm diam., 5-10 mm high, cupulate, laterally compressed initially, margin inrolled initially, hymenium dark brown when dried, smooth to slightly undulate-rugose, excipular surface dark brown near margin, medium brown below to yellowish brown at base, pubescent to densely pubescent, strongly ribbed, ribs blunt, single or bifurcate branched, no anastomosis between ribs, extending onto basal quarter to two thirds of excipular surface. **Stipe**: 15-19 x 3-6 mm, flared at apex, equal below, medium brown at apex to medium or light yellowish brown below when dried, pubescent, vestiture darker than background tissue, strongly ribbed, ribs blunt, branched and anastomosed, rarely lacunose, internally chambered. **Asci**: 300 x 19 (immature), pleurorhynchous. **Paraphyses**: 4.1-6.9 μm diam. at apex, terminal cell 30-40 μm long, clavate, enlarged gradually to apex, pale brown to brown in mass, contents finely granular. **Ascospores**: 16.1-17.8 x 10.1-10.9 μm (immature), broadly ellipsoidal, hyaline, smooth, uniguttulate.

Habitat: Gregarious on duff in coniferous woods. Associated trees: *Picea* sp. and *Tsuga* sp. Collected only on July 28 in AK.

Distribution: Rare in northern coastal regions from AK. This species is newly reported from Alaska and significantly extends the range westward in North America. Previously known only from northeastern North America (Harmaja 1981) and northern Europe (Harmaja 1978, 1979a). Map 13.

Notes: Harmaja (1979a) suggests this species is closest to *H. costifera* (q.v.), but *H. acetabulum* (q.v.) and *H. verruculosa* (q.v.) are equally close. Although immature, the specimens from Alaska are otherwise identical to the type collection from Finland. The two ascocarps were part of a larger collection of *H. leucomelaena* (q.v.), but are easily separated by their pleurorhynchous ascus base, in addition to the prominent, slender, distinctly ribbed stipe with dark pubescence and medium brown ascocarp.

Collections Examined: CANADA: Newfoundland: Labrador, north end of Astray Lake, southeast of Schefferville, Mäkinen (67-1371) 08 4 1967, TUR 66271. **USA: Alaska**: near Hope, Kempton 07 28 1968, WK 1542b. **FINLAND**: Juuma, Kuusamo, Harmaja 08 27 1970, H (holotype).

Helvella leucomelaena (Persoon) Nannfeldt, 1941, in Lundell and Nannfeldt Fungi Exsiccati Suecici Praesidium Upsaliensis Fasciculata 19-20: 21, no. 952.

≡*Peziza leucomelas* Persoon, 1822, Mycologica Europaea 1: 219.

=*Helvella confusa* Harmaja, 1977, Karstenia 17: 43. (holotype H, examined; isotype C, examined).

≡*Helvella solitaria sensu* Dissing 1966b; non *H. solitaria* P. Karsten.

=*Helvella pedunculata* Harmaja, 1978, Karstenia 18: 57. (holotype OULU, examined).

=*Acetabula calyx* Saccardo, 1873, Mycologieae Venetae Specimen p. 168. (holotype K, examined).

=*Peziza debeauxii* Roumeguère, 1882, Revue de Mycologie 4: 156. (syntype K, examined).

=*Helvella melaleuca* Rifai, (specimen labeled type at K, examined, but no reference found to this species in Rifai 1968 or in Index of Fungi).
(additional synonyms see Dissing 1966b).

Type Material: Lectotype selected here: L 8945-6, Herbarium Persoon, examined. **Figs. 3a, 20, 50.**

Apothecium: 4-60 mm diam., 3-34 mm high (up to 70 mm diam. fresh), deeply cupulate, initially subglobose and nearly closed, margin expanding at maturity to shallowly cupulate, often becoming split and somewhat reflexed, occasionally laterally compressed when immature, cups rarely irregular and repand when growing in clusters, hymenium dark brown to grey brown fresh, rarely with paler regions, when dry dark brown to blackish brown, smooth to slightly undulate-rugose, excipular surface brown to dark brown at margin, pallid brown below, white near base, pubescent, ribs absent or extending onto basal quarter only. **Stipe**: 1-20 x 1-15 mm, expanding and merging with apothecium, below equal or base rarely slightly enlarged, white, finely pubescent, sparingly ribbed, ribs broad and rounded, internally sulcate and solid or chambered. **Asci**: 225-330 x 14.6-20 μm, aporhynchous. **Paraphyses**: 4.9-9 μm diam. at apex, terminal cell 144-145 μm long, clavate, enlarged gradually to abruptly at apex, pale brown to brown, contents finely granular. **Ascospores**: 18-24.2 x 10.9-15 μm, broadly ellipsoidal to ellipsoidal, hyaline, smooth, with SEM finely rugose to smooth, uniguttulate.

Habitat: Solitary, gregarious, subcaespitose, or scattered and numerous on bare soil, moss, or litter in coniferous woods. Associated trees: *Pinus contorta, Pinus ponderosa, Abies lasiocarpa, Picea glauca, Picea engelmannii, Pseudotsuga menziesii, Larix occidentalis, Tsuga heterophylla, Thuja plicata, Populus tremuloides,* and *Alnus tenuifolia*. Associated shrubs: *Alnus crispa, Acer glabrum, Menziesia ferruginea,* and *Juniperus* sp. Fruiting from April 23 in WA and BC to September 3 in AB.

Distribution: Widely distributed in montane regions from AK, BC, AB, WA, ID, OR, and WY. Newly reported from WY. Also distributed in eastern North America (Weber 1972), South America (Dissing 1966b), Europe (Dissing 1966b, Häffner 1987; Calonge and Arroyo 1990), north Africa and the Middle East (Dissing 1966b; Nemlich and Avizohar-Hershenzon 1972, as *Paxina leucomelas*), Asia (Korf and Zhuang 1991; Waraitch 1976, as *H. solitaria*) and Australia (reported here based on the specimen labeled *H. melaleuca*). This species has the broadest global distribution of any in the genus, and is the only one found in South America. Map 12.

Notes: *Helvella confusa*, although recognized previously by Abbott and Currah (1988) and others (Harmaja 1977a), is considered a synomym. The species, originally treated as *H. solitaria* by Dissing (1966b) and described as the new species *H. confusa* by Harmaja (1977a), was separated from *H. leucomelaena* on the basis of ascocarp size, prominence of stipe, spore size, and fruiting time. Ascocarp size is a dubious character, as recognized by Dissing (1966b), and may reflect degree of maturity or differences in environmental conditions. Stipe development may vary with individual and habitat. Large collections of *H. leucomelaena* show wide variation in ascocarp size and stipe prominence and cover a range of features typical for *H. leucomelaena sensu stricto* and *H. confusa*. Stipe morphology varies in collections of other species including *H. solitaria* (q.v.) and *H. elastica* (q.v.). Our examination of type material showed that spores of *H. confusa* are slightly shorter than *H. leucomelaena*, but width showed the same range of variation, contrary to that reported by Dissing (1966b) and Harmaja (1977a). A number of collections with rather small spores were found, but other features did not correlate with those expected for *H. confusa*. Since the spore size difference is very slight and not correlated with other features of importance, it seems reasonable to accept a slightly greater range of variation for one widely distributed and variable species. Harmaja (1977a) suggests that *H. confusa* may have a slightly later fruiting time than *H. leucomelaena*, although the type collection is from May. A number of collections from northwest North America were examined from July and August. One from August (ALTA 8290) is typical for *H. leucomelaena* (*sensu stricto*) in all other respects including large ascocarp size, spores up to 23 μm long, and short indistinct stipe. Fruiting time, especially in montane environments, varies with environmental conditions, even for typically vernal species. Unusual fruiting times are also known for *H. maculata* (q.v.) and *H. acetabulum* (q.v.). Specimens referred to *H. leucomelaena* by Kempton and

Wells (1970) represent *H. crassitunicata* (q.v.), while specimens described as *H. solitaria* are *H. leucomelaena*.

Helvella pedunculata is a synonym for similar reasons. Harmaja (1978, 1979a) distinguished the species as having shorter ascospores, a well differentiated stipe, and slightly denser pubescence on the excipular surface. In fact, the table in Harmaja (1979a) showing key distinguishing features provides a good indication of the similarity between the three taxa (*H. leucomelaena, H. confusa, H. pedunculata*). The differences noted there, including details of the excipulum, are not diagnostic in these taxa.

The lectotype of *H. leucomelaena*, chosen from several excellent collections in the Persoon Herbarium, Leiden, is consistent with the description above in all details. *Helvella leucomelaena* (*sensu lato*) is characterized by the short, white stipe with well separated blunt ribs which do not extend noticeably onto the finely pubescent excipular surface, darkly pigmented hymenium, relatively large ascospores, and aporhynchous ascus base.

Collections Examined: **CANADA:** **British Columbia**: Canal Flats, Funk 06 26 1960, DAOM 82875; Lumby, Bandoni 05 28 1960, UBC F3398; Procter, Linton 05 15 1978, UVIC; Jocelyn Hill, highlands near Victoria, Ceska 04 23 1977, UVIC. **Alberta**: near Nojack, Abbott (SA 56, 57, 84) 06 24 & 29 1989, SA; Winfield, Strand 07 8 1975, ALTA 7342; Penstock Creek, Jasper N.P., Currah 08 29 1987, ALTA 8274; Moraine Lake, Banff N.P., Suttill 09 3 1980, UVIC; Marmot Creek basin near Seebe, Danielson (RMD 309) 08 13 1972, ALTA 8290; Summit Lake trail, Waterton Lakes N.P., Egger (731) 08 11 1980, DAOM 177741, SA; Bertha Lake trail, Waterton Lakes N.P., Egger (602) 07 7 1980, DAOM 177719; Crandell Lake trail, Waterton Lakes N.P., Abbott (SA 322) 05 27 1990, SA; Bauerman Creek trail, Waterton Lakes N.P., Abbott (SA 335) 05 28 1990, SA; Upper Waterton Lake trail, Waterton Lakes N.P., Abbott (SA 340) 05 28 1990, SA. **Ontario**: Halton Forest, Halton Co., Ammirati (JFA 8022) 05 18 1978, WTU. **Québec**: southeast ends of John Lake and Dolly Lake, Schefferville, Kallio & Mäkinen 07 28 1978, TUR 63428. **Newfoundland**: Labrador, northeast end Astray Lake, southeast of Schefferville, Kallio & Heikkilä 08 4 1967, TUR 53429, 66269, 66270, 66272. **USA:** **Alaska**: Eklutna Lake north of Anchorage, Kempton 07 13 1966, WK 1538, 1539; Hope road, Kempton 07 28 1968, 07 14 1970, WK 1542a, 4480; Turnagain Pass on Seward Highway, Kempton 08 27 1968, WK 1553. **Washington**: Friday Harbor, San Juan Island, Isaacs (Is 1704) 05 19 1962, WTU; Entiat Mountains, Chelan Co., Ammirati (JFA 9400) 06 7 1987, WTU; Cle Elum pine flats, Isaacs (Is 1738) 05 27 1962, WTU; Cle Elum pine flats, Stuntz (Stz 12310, 11709) 05 21 & 22 1960, WTU; Cle Elum pine flats, McCarkle (Stz 11691) 05 15 1960, WTU; near Yelm, Walters (JFA 8499) 05 4 1981, WTU; Ewartsville, Whitman Co., Duran 05 1 1983, WSP 67339; Kamiak Butte, Whitman Co., Cooke 05 17 1948, WSP 29343; WSU campus, Pullman, Sulzbach 04 23 1963, WSP 53392; WSU campus, Pullman, Waldron 05 9 1963, WSP 51810; Boulder Lake trail, (Stz 8835) 08 2 1954, WTU; unknown, Snyder 05 5 1934, (Stz 10977) 05 24 1959, WTU. **Idaho**: Priest Lake, Slipp 05 27 1941, WSP 50807; Priest River Experimental Forest, Bonner Co., A.H. Smith 07 5 1964, WSP 54318; Ida Creek, Priest River Experimental Forest, Slipp 06 11 1942, WSP 55594; Coeur d'Alene National Forest, Shoshone Co., Scates (1962) 06 30 1972, MICH; Dry Creek between Troy and Deary, Cooke 05 1948, WSP 30102; Laird Park, Latah Co., Paden (JWP 515) 05 20 1967, UVIC; Payette Lake, Valley Co., Smith (44737) 07 2 1954, MICH; Karney Lakes, Boise Co., Trueblood (1029) 05 8 1960, MICH; Idaho, English, WSP 23948. **Oregon**: Bear Springs, Wasco Co., Carson 06 3 1951, MICH. **Wyoming**: north Fork French Creek, Medicine Bow Mountains, Albany Co., Smith (35784) 08 15 1950, MICH. **ARGENTINA**: La Plata, Ceppi 08 1936, ex Herbario Spegazzini (2235) Museo De La Plata, TRTC. **SWEDEN**: Älvkarleby parish northeast of Gardskär, Eriksson & Lundquist 06 30 1965, K. **FINLAND**: Kiiminki, Keskikylä, Esteri & Ohenoja 07 2 1975, OULU (holotype of *H. pedunculata*). **DENMARK**: Klitmoller, northern Jutland, Toft & Dissing 05 15 1965, H, (holotype of *H. confusa*), C (isotype of *H. confusa*). **NETHERLANDS**: Herbarium Persoon, L 8943-7, L 8945-4, L 8945-5, L 8945-6 (lectotype), L 8945-8. **ITALY**: Padova, Saccardo, Herbarium Cooke 1885, K (type of *Acetabula calyx*). **AUSTRALIA**: K (holotype of *H. melaleuca*). **Exsiccata**: Roumeguère Fungi Gallici Exsiccati, 2174, Algeria, Debeaux 04 1882, s.n. *Peziza debeauxii*, K (syntype of *P. debeauxii*); Kryptogamae exsiccatae, 1824, near Baden, Austria, De Höhnel, IMI 11963.

Helvella robusta S.P. Abbott, 1988, in Abbott and Currah, Mycotaxon 33: 242.

Type Material: Holotype DAOM, examined; paratype ALTA, examined.

Fig. 25.

Apothecium: 50-90 mm diam., irregularly cupulate or centrally depressed with margins reflexed, hymenium when dry medium brown, undulate-rugose, excipular surface when dry white to pale brown, pubescent, prominently ribbed, ribs branching and anastomosing, extending to marginal region. **Stipe**: 30-50 x 30-50 mm, expanding and merging with apothecium, white to pale brown, pubescent, prominently ribbed and lacunose, ribs branching and anastomosing, internally chambered. **Asci**: 220-345 x 15-19.3 μm, pleurorhynchous. **Paraphyses**: 4.5-7.5 μm diam. at apex, terminal cell 65-75 μm long, clavate, enlarged gradually to apex, pale brown in mass, contents finely granular. **Ascospores**: 15-19 x 10.5-14 μm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary on soil under deciduous trees. Associated trees and shrubs: *Populus balsamifera* and *Salix* sp. The type locality is a dry hilly grassland with poplars and shrubs in ravines and gullies. This habitat is unlike that of any other species of *Helvella* examined in this study. Fruiting from August 30 to September 11 in AB.

Distribution: Rare in parkland regions. This species is known only from AB (Abbott and Currah 1988, 1989). Map 14.

Notes: The large size, robust prominently ribbed stipe, strongly reflexed apothecial margins, and autumnal fruiting are characteristic. Closely related species include *H. costifera* (q.v.), *H. unicolor* (q.v.), and *H. acetabulum* (q.v.). Autumnal fruiting indicates a close relationship with *H. costifera*, which differs in its grey coloration, smaller stature, and narrower paraphyses. *Helvella unicolor* is similar in ascospore size and shape, but differs in size, colour, and excipular vestiture. *Helvella acetabulum* is more darkly pigmented with slightly longer ascospores, and fruits earlier.

Collections Examined: CANADA: **Alberta**: Nose Hill area, Calgary, Danielson (RMD 459) 08 30 1972, DAOM 143869 (holotype); Glenmore Park, Calgary, Danielson (RMD 537) 09 11 1972, ALTA 8291 (paratype).

Helvella solitaria P. Karsten, 1871, Bidrag Kännedom af Finlands Natur och Folk 19: 37. (unintentional *nomen novum*).

≡*Peziza solitaria* P. Karsten, 1869, Notiser ur Sällskapets pro Fauna et Flora Fennica Förhandingar 10: 115. (illegitimate, later homonym); non *Peziza solitaria* Schweinitz.

≠*Helvella solitaria, sensu* Dissing 1966b (=*H. leucomelaena*).

=*Helvella queletii* Bresadola, 1882, Revue de Mycologie 4: 211. (*fide* Harmaja 1977a).

(additional synonyms see Dissing 1966b as *H. queletii*)

Type Material: Holotype H, examined.

Fig. 3b.

Apothecium: 13-60 mm diam., 4-44 mm high (up to 120 x 50 mm fresh), cupulate, often laterally compressed initially, often becoming bilobate, shallowly cupulate, or somewhat reflexed in age, margin slightly inrolled initially, hymenium grey brown to dark brown fresh, when dry dark grey brown to blackish brown, smooth to slightly undulate-rugose, excipular surface medium to dark grey brown at margin, base typically paler grey brown to white, pubescent to densely pubescent, ribs absent or extending very slightly onto base of excipular surface. **Stipe**: 7-105 x 2-50 mm (up to 120 x 50 mm fresh), equal or enlarged at base, apex flaring slightly, white to pale or grey brown, occasionally dark grey brown at apex, finely pubescent to pubescent, highly ribbed or rarely with sparse ribbing, ribs simple or branching and anastomosed, sulcate and internally solid or with few chambers. **Asci**: 240-300 x 14-18 μm, pleurorhynchous. **Paraphyses**: 7-8 μm diam. at apex, terminal cell 89-144 μm long, clavate, brown, contents finely granular. **Ascospores**: 17-21 x 11-13.5 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary or often gregarious to numerous and scattered on ground in soil or litter in coniferous, mixed, or occasionally deciduous woods. Associated trees: *Picea glauca, Picea engelmannii, Pinus contorta, Pseudotsuga menziesii, Abies grandis, Abies* sp., *Tsuga heterophylla, Thuja plicata, Populus tremuloides, Populus balsamifera, Betula papyrifera,* and *Alnus* sp. Associated shrubs: *Salix bebbiana, Rosa* sp., *Lonicera involucrata,* and *Cornus stolonifera.* Fruiting from April 19 in coastal WA to October 4 in eastern WA. April and May collections are known only from WA and OR, June to August collections are typical for AK, NWT, AB, MB, ID, and WY.

Distribution: Widely distributed in boreal, montane, coastal, and arctic regions from AK, NWT, BC, AB, SK, MB, WA, ID, OR, and WY. Also distributed in eastern North America (Weber 1972, as *H. queletii*) and Europe (Dissing 1966b, as *H. queletii*; Harmaja 1977; Häffner 1987). Map 15.

Notes: Closely related species in the subgenus *Leucomelaenae* include *H. costifera* (q.v.) which is similar in colour, but distinguished by more prominent ribbing on stipe and excipular surface and relatively broader stipe. *Helvella hyperborea* (q.v.) is similar in ascocarp shape, but can be distinguished by the prominent ribbing of the excipular surface and ascocarp colour. *Helvella unicolor* (q.v.) is easily distinguished by ascospore shape. *Helvella solitaria* is also similar to *H. leucomelaena* (q.v.), which is aporhynchous and has larger ascospores.

This variable species may provide an indication of relationships between the subgenus *Leucomelaenae* and other subgenera. Small, cupulate specimens are similar in many respects to species in the subgenus *Cupuliformae* (*H. cupuliformis* (q.v.), which never attains a large size, has an unpigmented stipe, and lacks prominent ribbing on the stipe with the ribs always absent from the base of the excipulum and *H. chinensis* (q.v.) which is a similar colour, but can be separated by ascospore size as well as the characters mentioned above for *H. cupuliformis*). Large specimens of *H. solitaria* are similar to members of the subgenus *Helvella*. The strongly ribbed, elongate stipe which is sometimes chambered, and the brown somewhat reflexed apothecium are reminiscent of *H. maculata* (q.v.) in particular.

Collections Examined: CANADA: Northwest Territories: east of Repulse Bay, Ohenoja 08 4 1974, DAOM 155395; Baker Lake, Ohenoja 08 9 1974, DAOM 155395; Fort Smith, Loan 08 8 1950, DAOM 26124. **British Columbia**: Tetsa River P.P., Abbott (SA 229) 08 22 1989, SA; Kokanee Glacier P.P. near Nelson, Harrison (6061) 07 11 1960, MICH; Gold Creek near Golden Ears P.P., Rabas 06 27 1971, UBC F3392; Golden Ears P.P., Redhead & Liu 06 7 1970, UBC F3393; Manning P.P., Morrison 08 3 1963, UBC F3397. **Alberta**: Shaw Lake near Lac La Biche, Abbott (SA 99, 101, 103) 07 14 & 15 1989, (SA 362, 366) 06 22 1990, SA; Cross Lake P.P., Abbott (SA 1012) 06 23 1994, SA; near Redwater, Currah (SA 481) 07 6 1991, SA; Wagner Natural Area, Abbott (SA 941, 1045) 07 6 & 09 4 1994, SA; Devonian Botanic Garden near Devon, Abbott (SA 443) 06 15 1991, SA; Poplar Creek Natural Area near Breton, Osis (SA 811) 07 11 1993, SA; Forestry Trunk road near Sundre, Abbott 07 19 1988, UAMH M565; Fish Creek P.P., Calgary, Danielson (RMD 911) 07 25 1973, ALTA 8295; Brown-Lowery Natural Area, Danielson (RMD 214) 07 29 1972, DAOM 143867. **Saskatchewan:** Prince Albert N.P., Zelmer (PA 133) 1994, ALTA. **Manitoba**: Russell, Bisby 06 20 & 30 1921, DAOM 206810; Manitoba Agricultural College, Winnipeg, Bisby 06 16 1925, DAOM 206820; Birds Hill, Bisby 07 1 1927, 07 6 1935, DAOM 206809, 206819. **USA: Alaska**: Matanuska Glacier, north of Palmer, Kempton 07 13 1964, 07 18 1971, WK 1546, 5058; Eklutna Lake north of Anchorage, Kempton 07 2 1973, WK 5290; Thunderbird Falls, Kempton 06 27 & 07 5& 11 1960, 07 10 1973, WK 1540, 1541, 1545, 5291; Thompson subdivision, Anchorage, Kempton 07 22 & 08 10 1971, WK 5079, 5131; Erickson Gold Mine, Girdwood, south of Anchorage, Kempton 08 17 & 09 3 1968, WK 1543, 1544; Potter, Kempton 09 11 1971, WK 5526. **Washington**: Friday Harbor, San Juan Island, Brough (Is 58) 04 21 1957, WTU; Friday Harbor, San Juan Island, Stuntz & Isaacs (Is 1703), WTU; Seattle, Greene (Snyder 122) 05 1929, WTU; Watermain woods, Redmond, Stuntz (Stz 21769) 04 19 1981, WTU; Watermain woods, Redmond, Jones (SLB 289) 01 1 1974, WTU; eastern Washington, Chiltan (Stz 19075) 10 5 1975, WTU; Lower Tahoma at Fish Creek, Stuntz (Stz 3902) 08 9 1948, WTU; Gold Creek campground, van de Bogart (Stz 13496) 04 30 1966, WTU; southwest of Fort Lewis, Hellya (Stz 7364) 05 14 1961, WTU; Aspus Centre, Masford (Stz 16672) 06 25 1971, WTU. **Idaho**: southwest of McCall, Miller 07 14 1964, WSP 54644; Coyote Creek, Owyhee Co., Trueblood (2174) 07 6 1963, MICH. **Oregon**: Hood River, Kienholz 05 16 1933, WSP 15136. **Wyoming**: Moose, Teton National Forest, Teton Co., Cain 07 1 1955, TRTC 31911; Medicine Bow National Forest, Albany Co., Kanouse 09 5 1923, MICH. **New York**: east of Lewis, Essex Co., Cain 06 15 1968, TRTC 45919. **NORWAY**: Østfold, Kråkerøy, Fuglevik, Kirkebakken, Kristiansen 06 7 & 20 1987, RK 87.10. **FINLAND**: Mustiala, Karsten (PAK 3288) 09 21 1866, H (holotype). **RUMANIA**: Mutenia, district Dâmbovita-Badulesti, Racovitza & Savulescu 07 5 1944, IMI 28970. **Exsiccata**: Ellis and Everhardt's Fungi Columbiani, 1801, Stockton, Kansas, USA, Bartholomew 06 3 1903, s.n. *Acetabula vulgaris*, K, WSP 2; Fungi Dakotenses, 502, Nyland's Grove, Kulm, North Dakota, Brenckle 07 4 1922, s.n. *Acetabula vulgaris*, WSP 23419.

Helvella unicolor (Boudier) Dissing, 1966, Revue de Mycologie 31: 219.

≡*Acetabula unicolor* Boudier, 1917, Bulletin de la Societé Mycologique de France 33: 14, plate 22 Figure 3.

Type Material: Neotype PC (selected Dissing 1966a), examined.

Figs. 3c,d.

Apothecium: 4-22 mm diam., 2-18 mm high (up to 52 x 30 mm fresh), deeply cupulate, becoming shallowly cupulate or somewhat repand, margin inrolled initially, expanding to slightly reflexed at maturity, hymenium medium to dark grey brown fresh, when dried blackish brown, smooth initially, typically becoming somewhat undulate-rugose at maturity, excipular surface medium to dark grey brown, typically slightly paler than hymenium, when dried medium to dark brown, densely pubescent to villose, ribs absent or extending onto basal two thirds of excipular surface. **Stipe**: 2-16 x 1-9 mm (up to 27 x 17 mm when fresh), equal, tapered to base, or base enlarged, white to cream, when dry cream to brown, finely pubescent to pubescent, sparingly ribbed or fluted when immature, becoming prominently ribbed at maturity, ribs blunt, sulcate and solid or with few chambers. **Asci**: 16.7-18.8 µm diam., pleurorhynchous. **Paraphyses**: 4.5-6.6 µm diam. at apex, terminal cell 81-170 µm long, clavate, enlarged gradually to apex, pale brown, contents finely granular. **Ascospores**: 17.4-20.8 x 13.1-15.2 µm, very broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Gregarious to scattered on soil in mixed woods. Associated trees: *Betula papyrifera, Alnus tenuifolia, Populus tremuloides, Populus balsamifera,* and *Picea glauca*. Associated shrubs: *Salix discolor* and *Viburnum edule*. Found in the study area only on August 7 in AB.

Distribution: Rare in boreal forest region east of the Rocky Mountains from AB. This species is newly reported for North America. Also distributed in Europe (Dissing 1966a, b). Map 12.

Notes: The species, as described here based on North American collections, differs from the type collection and other European collections in several respects. European collections have a finely pubescent excipulum, although Dissing (1966a) described loose tufts of fascicled hyphae projecting from the outer excipulum, which were also observed here. European collections also have an earlier fruiting period from March to May (Dissing 1966b). European and North American specimens possibly represent distinct varieties or species, but the similarity in ascocarp morphology and the distinctive broad ascospores suggest they are conspecific. More collections from North America and fresh collections from Europe should be examined to provide a clear concept of this taxon. *Helvella unicolor* is similar to *H. solitaria* (q.v.) and shares the overall ascocarp morphology, and in both species the stipe varies from slender and sparingly ribbed to robust and distinctly ribbed. They differ in ascospore size and shape, and the ribs which extend onto the excipulum in *Helvella unicolor*. *H. unicolor* is similar to *H. costifera* (q.v.), *H. acetabulum* (q.v.), and *H. verruculosa* (q.v.). *Helvella costifera* shares the greyish coloration of fresh specimens and blunt ribs of stipe and excipulum. *Helvella acetabulum* shares the brown coloration seen in dry specimens, but *H. unicolor* lacks the yellow pigments often seen on excipular surface and stipe. Both species have less pubescence on the excipulum than the specimens described here. *H. verruculosa* shares ascocarp coloration, smaller size, less pronounced stipe, variable degree of ribbing on excipular surface, blunt ribs, and densely pubescent excipular surface. *Helvella unicolor* is found in boreal regions with a more southerly distribution than the arctic and alpine *H. verruculosa*. Very broad ascospores are also seen in *H. robusta* (q.v.) and *H. aestivalis* (q.v.).

Collections Examined: **CANADA:** **Alberta**: Notikewin P.P., Abbott (SA 131, 132, 135, 139) 08 7 1989, SA. **FRANCE**: commune de Savigné, Vienne, Grelet 04 22 1927, PC (neotype); France, Riousset 03 1974, K.

Helvella verruculosa (Saccardo) Harmaja, 1978, Karstenia 18: 57.

≡*Geopyxis verruculosa* Saccardo, 1889, Sylloge fungorum 8: 68. (unintentional *nomen novum*).

≡*Peziza verruculosa* Berkley and Curtis, 1860, Proceedings of the American Academy of Arts and Sciences 4: 127 (illegitimate, later homonym); non *Peziza verruculosa* Weinmann, 1827, Sylloge plant. nov. 2: 111.; nec *Peziza verruculosa* Berkley and Broome, 1875, Journal of the Linnean Society London 14: 105.

=*Helvella arctoalpina* Harmaja, 1978, Karstenia 17: 58. (Holotype O, examined).

=*Helvella dryadophila* Harmaja, 1978, Karstenia 17: 58. (Holotype O, examined).

Type Material: Holotype K, examined; isotype FH.

Fig. 11a,b.

Apothecium: 8-30 mm diam., 3-14 mm high, cupulate, margin inrolled initially, expanding at maturity, hymenium when dried blackish brown to black, smooth to slightly rugose, excipular surface dark brown at margin, pale brown to yellow brown at base, densely pubescent, margin villose and sometimes with distinct white hairs, base pubescent, with ribs extending onto basal half of excipular surface. **Stipe**: 5 x 6-9 mm, nearly equal to tapered to base, when dry white to cream or rarely pale brown at apex, pubescent to finely pubescent, distinctly ribbed, ribs sharp or blunt with little branching and anastomosis, sulcate and solid or with few chambers. **Asci**: 250-300 x 14-16.7 µm, pleurorhynchous. **Paraphyses**: 5.1-7.7 µm diam. at apex, apical cell 32-124 µm long, clavate, gradually enlarged to apex, pale brown to brown, dark brown in mass, contents finely granular. **Ascospores**: 17.8-22.1 x 11.8-13.5 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary to gregarious or scattered and numerous on soil or humus with low shrubs in tundra. Associated shrubs: *Salix reticulata*, *Salix arctica*, *Vaccinium vitis-idaea*, *Cassiope* sp., and *Dryas integrifolia*. Fruiting from July 30 to August 15 in NWT.

Distribution: Widely distributed in arctic and alpine tundra regions in northern areas from NWT and AB. This species is newly reported for North America. Circumpolar distribution in North America, Europe (Harmaja 1977b; Schumacher and Mohn Jenssen 1992; as *H. arctoalpina*), and Asia (Harmaja 1979a). Map 13.

Notes: This species is most similar to *H. aestivalis* (q.v.)(see notes under that species), *H. costifera* (q.v.) and *H. acetabulum* (q.v.). Dissing (1966b) and Pfister (1977) considered it an arctic form of *H. acetabulum*, but Harmaja recognized distinct species. Harmaja (1978, 1979a) verified the status of *Geopyxis verruculosa* Saccardo as a valid species closely related to *H. arctoalpina* and *H. dryadophila*. Unfortunately, the problem was complicated by Harmaja's (1977b) description of the two new species from arctic collections. On examination of holotypes, *H. verruculosa* is the oldest valid name for this arctic and alpine taxon, with *H. arctoalpina* and *H. dryadophila* considered conspecific. In fact, the table in Harmaja (1977b) listing pertinent distinguishing characters is more useful if the three species are combined. The features used by Harmaja to separate *H. verruculosa*, *H. arctoalpina*, and *H. dryadophila* include spore size and shape, details of the excipulum in cross section, and length of the terminal cell of the paraphyses. All of these are variable in other species of this genus and no correlation was found that would make separation possible. *Helvella acetabulum* and *H. costifera* are larger and have more prominent stipes, more pronounced ribbing and anastomosis of ribs on the excipular surface and stipe, finely pubescent excipular surface, and temperate distribution.

Collections Examined: **CANADA:** **Northwest Territories**: Blister Hill Creek delta near Hazen Lake, Ellesmere Island, Powell, 07 30 1958, DAOM 67088; Skeleton Creek north of Hazen camp, Ellesmere Island, Forest 08 10 1962, DAOM 91575; southwest of Hazen camp, Ellesmere Island, Savile 07 30 1962, DAOM 91574; Fox valley southwest of Hazen camp, Ellesmere Island, Savile 07 30 1962, DAOM 91576; Tanquary Fjord, Ellesmere Island N.P., Richards (79) 07 26 1994, ALTA; Bathurst Island, Bissett 08 6 & 15 1977, DAOM 165336, 165335; Stanwell-Fletcher Lake, Somerset Island, Savile 08 11 1958, DAOM 60267; northeast of Repulse Bay, Ohenoja 08 5 1974, DAOM 159682; southeast of Repulse Bay, Ohenoja 08 4 1974, DAOM 155308; Coral Harbor, Southampton Island, Cody 08 6 1948, DAOM 20767; Coral Harbor, Southampton Island, Savile 08 15 1959, DAOM 67075; Longstaff Bluff, Baffin Island, Parmelee & Seaborn 08 7 1967, DAOM 117583; near Melvin Bay, Rankin Inlet, Ohenoja 08 12 1971, DAOM 159712. **Alberta**: Cardinal River Divide near Cadomin, Annett (SA 624) 08 1982, SA. **SVALBARD**: Gipsvika, Currah 08 15 1988, ALTA 8308. **NORWAY**: Lom, Oppland, Eckblad 08 29 1957, O (holotype of *H. dryadophila*); Eidfjord, Hordaland, Eckblad 08 1 1959, O (holotype of *H. arctoalpina*). **USSR**: Russian S.F.S.R., Magadan obl., Chukotski Peninsula, Arakamachene Island, Bering Strait, Stony Hills, Wright 08 11 1855, K (holotype of *Geopyxis verruculosa*).

Extralimital Species

Helvella oblongispora Harmaja, 1978, Karstenia 18: 57.

Type Material: Holotype C, examined.

Fig. 24.

Distribution: *H. oblongispora* is known from Europe (Harmaja 1978, 1979a, 1982; Häffner 1987) and Asia (Cao *et al.* 1990).

Notes: This species differs from *H. leucomelaena* (q.v.) in having a paler brown to ochre brown apothecium and more prominent ribbing on stipe and basal third of excipular surface. *Helvella oblongispora* resembles *H. unicolor* (q.v.) in gross morphology, but can easily be separated by colour, excipulum vestiture, ascal base, and ascospore shape.

Collections Examined: **GERMANY**: near River Isar, Munich, Einhellinger 07 23 1969, C (holotype).

Helvella ulvinenii Harmaja, 1979, Karstenia 19: 42.

Type Material: Holotype H, examined; isotype OULU.

Distribution: Known only from Europe (Harmaja 1979a).

Notes: This species is tentatively accepted. Comparative studies are needed to clearly delimit this taxon from *Helvella solitaria* (q.v.), *H. alpestris* Boudier (see Häffner 1987), and *H. dovrensis* T. Schumacher (Schumacher 1992; Schumacher and Mohn Jenssen 1992).

Collections examined: **FINLAND:** prov. Enontekiön Lappi, par. Enontekiö, Kilpisjärvi, Harmaja 08 25 1979, H (holotype).

Helvella **Subgenus** ***Macropodes*** (Dissing) S.P. Abbott *comb. nov.*

≡*Helvella* section *Macropodes* Dissing, 1966, Dansk Botanisk Arkiv 25: 62, emend. Häffner, 1987, Beihefte zur Zeitschrift für Mykologie 7: 92.

Type Species: *Helvella macropus* (Persoon : Fries) Karsten, 1870, Notiser ur Sällskapets pro Flora et Fauna Fennica Förhandlingar 11: 224. (Monotypic).

Ascocarp: stipitate, cupulate to discoid; hymenium brown, smooth; excipular surface brown to grey brown, densely pubescent to villose, lacking ribs; stipe equal or tapered at apex, brown to grey brown, densely pubescent to villose, terete to shallowly fluted, internally solid. **Asci**: pleurorhynchous. **Ascospores**: subfusoidal to ellipsoidal, smooth to verruculose, with SEM distinctly verrucose at maturity, with numerous small isolated pointed warts, triguttulate or rarely uniguttulate, with large central subglobose oil guttule and typically two smaller globose polar guttules.

Notes: Häffner (1987) restricted the section *Macropodes* to one species, *H. macropus*, (based on subfusoidal and triguttulate spores which are verrucose at maturity). The spores are often subfusoidal, but some spores in each mount are more or less ellipsoidal. These ellipsoidal spores, and some of the subfusoidal ones, typically possess only one large central guttule typical of *Helvella*. In fact, in some collections the uniguttulate spores outnumber the triguttulate ones. Ascospore ornamentation as observed with SEM shows mature spores of *H. macropus* with numerous small, pointed spines (Figs. 53-56). However, submature spores in the same apothecia can be finely rugose (Fig. 57) and virtually indistinguishable from the pattern of ornamentation seen in all other members of the genus (Figs. 45-52). Other species of section *Macropodes* (*sensu* Dissing 1966b) are referred to subgenus *Cupuliformae* here. The genera *Macropodia* and *Macroscyphus* were established with *H. macropus* as type, recognizing the taxonomic isolation of this species.

Helvella macropus (Persoon : Fries) P. Karsten, 1870, Notiser ur Sällskapets pro Flora et Fauna Fennica Förhandlingar 11: 224.

≡*Peziza macropus* Persoon : Fries, 1823, Systema Mycologicum 2: 57.

≡*Peziza macropus* Persoon, 1796, Observationes Mycologicae 2: 26.

≡*Cyathipodia macropus* (Persoon : Fries) Dennis, 1960, British Cup Fungi, p. 7.

=*Peziza subclavipes* W. Phillips & Ellis, 1887, in Ellis and Everhart, North American Fungi, Number 985. (Lectotype selected here: NY, Newfield, New Jersey, USA, Phillips (3651) 06 6 1882, examined).

≡*Paxina subclavipes* (W. Phillips & Ellis) Seaver, 1928, The North American Cup-Fungi (Operculates), p. 206.

≡*Macropodia subclavipes* (W. Phillips & Ellis) Rehm, 1904, Annales Mycologici (Berlin) 2: 35.

=*Helvella macropus* var. *brevis* Peck, 1902, Bulletin of the Torrey Botanical Club 29: 74. (holotype NYS, examined).

≡*Helvella brevis* (Peck) Harmaja, 1974, Karstenia 14: 104.
(additional synonyms see Dissing 1966b).

Type Material: unknown (*fide* Dissing 1966b).

Figs. 9, 18, 53-57.

Apothecium: 5-35 mm diam., 4-12 mm high, deeply cupulate, expanding to shallowly cupulate or discoid in age, often laterally compressed initially, margin inrolled initially, hymenium dark brown (fresh and dried), smooth, excipular surface light to medium brown or grey brown, sometimes with olivaceous tints, densely pubescent to villose. **Stipe**: 4-60 x 1-9 mm when fresh, equal or enlarged at base, apex typically tapered, light to medium grey brown, densely pubescent to villose, terete or fluted over basal half, terete to slightly sulcate and internally solid. **Asci**: 175-250 x 14-18 µm. **Paraphyses**: 5-9.6 µm diam. at apex, clavate, enlarged gradually to abruptly at apex, pale brown to brown in mass, contents finely granular. **Ascospores**: 18-25.1 x 10.3-12.2 µm, subfusoidal, hyaline, smooth to verruculose, with SEM distinctly verrucose with numerous small, isolated, pointed warts, triguttulate or infrequently uniguttulate.

Habitat: Solitary to gregarious on litter or soil, infrequently on rotted wood, in deciduous, mixed, or coniferous woods. Associated trees: *Betula papyrifera, Alnus* sp., *Picea glauca*, *Abies balsamea*, and *Thuja plicata*. Associated shrubs: *Alnus crispa* and *Lonicera involucrata*. Fruiting from July 18 in BC to October 19 in WA.

Distribution: Widely distributed throughout boreal, montane, and coastal regions from AK, BC, AB, MB, WA, and ID. Also in eastern North America (Weber 1972; Rehm 1904, as *Macropodia subclavipes*), southern North America (Seaver 1928, as *Paxina subclavipes*), Europe (Dissing 1966b; Häffner 1987), Asia (Dissing & Nannfeldt 1966; Liu *et al.* 1985), and Central America and the Caribbean (Dissing 1966b). Map 19.

Notes: Variation in the distinctive verrucose ascospore ornamentation is illustrated in Figs. 53-56. *Helvella macropus* is similar in habit to species in the subgenus *Cupuliformae*. *Helvella cupuliformis* (q.v.) and *H. chinensis* (q.v.) show the greatest similarity, but differ in colour and ascospore morphology. Collections referred to as *Helvella macropus* var. *brevis* or *Helvella brevis* in recent literature on the genus (Weber 1972; Harmaja 1974a; Abbott and Currah 1988) are considered conspecific here. Seaver (1928) recognized *Paxina subclavipes* and listed *Helvella macropus brevis* as a synonym, and Dissing (1966b) listed *P. subclavipes* as a synonym of *H. macropus*. There are several specimens of *P. subclavipes* from the Ellis collections, as well as several packets of Ellis North American Fungi Number 985, (NY). Of these, one collection (Phillips, June, 1882) annotated by Ellis is the oldest collection from which the species was originally described. It is selected as lectotype of *Peziza subclavipes*. Some specimens of *H. chinensis* (q.v.) were distributed as *Peziza subclavipes* in Ellis & Everhart Fungi Columbiani 1219.

Collections Examined: CANADA: British Columbia: Clearwater Lake area, Wells Gray P.P., Goward 08 28 1980, DAOM 186405; Clearwater River, Goward 08 20 1980, DAOM 194786; Mount Revelstoke N.P., Shoemaker 07 18 1963, DAOM 107075; near Mike Lake, Garibaldi P.P., McClaren 07 1964, UBC F3217; Golden Ears P.P., Kroeger 08 1 1982, UBC F1018. **Alberta**: near Fort McMurray, Danielson (RMD 1460) 07 31 1974, ALTA 8294; Iosegun Lake east of Fox Creek, Abbott (SA 120, 124) 08 6 1989, SA; Devonian Botanic Garden near Devon, Abbott (SA 1221) 08 24 1996, SA. **Manitoba**: Victoria Beach, Bisby 08 8 1928, DAOM 206817. **Ontario**: Black Sturgeon Lake, Redhead (1084) 08 8 1974, TRTC 47330; Ottawa, Malloch & Ginns 08 10 1972, TRTC 47743. Stethan Lake, Sudbury District, Malloch 09 12 1972, TRTC 47742; U of T forest, Muskoka District, Cain 09 17 & 18 1965, TRTC 43145, 43158. **Québec**: Reserve Chibougamau, Stanis 08 20 1976, TRTC. **USA**: **Alaska**: near Talkeetna, Kempton 08 26 1972, WK 5252; Thunderbird falls trail, north of Anchorage, Kempton 08 8 1960, WK 1554; Alaska Pacific University campus, Anchorage, Kempton 08 31 & 09 28 1971, WK 5400, 5676; Anchorage, Kempton 07 21 1979, WK 6368; Finger Lake, Matanuska valley, Kempton 08 5 1968, 09 25 1973; Nancy Lake, Susitna valley, Kempton 08 15 1968, WK 1559. **Washington**: Issaquah, van de Bogart (FVB 3565) 10 11 1975, WTU; Fall City, Thompson 08 3 1963, WTU; Lower Tahoma River, Mount Rainier N.P., Imshaug 07 30 1948, DAOM 24706; Hood Canal are, State Park, Waugh 08 1968, DAOM 126108; unknown, PSMS (Stz 15660) 10 19 1969. **Idaho**: Upper Priest River, Boundary Co., Smith (NJS 2002) 09 21 1968, MICH; Tule Bay, Beaver Creek, Priest Lake, Bonner Co., Smith (NJS 2120) 10 3 1968, MICH. **Wisconsin**: Algona, Dodge 08 11 1904, WSP 52070. **Michigan**: Tahquamenon Falls State Park, A.H. Smith 08 7 & 12 1963, UBC F3210, F3215; Cross Village, Emmet Co., Shaffer 08 5 1964, UBC F952; Mud Lake near Cheboygan, Brough 07 19 1963, UBC F3214; north of Lewiston, A.H. Smith 07 31 1963, UBC F3209; Ogemaw Co., Brough 07 23, 08 5 1963, UBC F3211, 3213; Reese's Bog, A.H. Smith 07 19 1963, UBC F3208; Grass Bay, Brough 07 9 1963, UBC F3212. **New York**: Ithaca, Long 07 22 1902, WSP 3109. **Massachusetts**: Massachusetts, Morris, NYS (holotype of *H. macropus* var. *brevis*); Massachusetts, Davis 1906, NYS. **New Jersey**: Newfield, Phillips (3651) 06 6 1882, NY (lectotype of *Peziza subclavipes*); Newfield, Ellis (3709), K; Newfield, Ellis collection 09 27 1882, NY; campground, Newfield, Ellis collection 11 1882, NY; Newfield, Ellis Collection 09 1899, NY; Newfield, Herbarium Massee, NY; Plainfield, Meschutt 07 2 1882, NY. **JAPAN**: between Yuno-ko and Karikomi-ko, Honshu Island, Cannon 08 23 1983, IMI 312582. **Exsiccata**: Rabenhorst Fungi europaei, 1413, Oberösterreich, Schiedermayr 09 1870, s.n. *Helvella macropus*, K. Ellis North American Fungi, 985, Newfield, New Jersey, USA, 06 & 09 1882, s.n. *Peziza subclavipes*, NY (packets A & B), K.

Helvella Subgenus *Silvicolae* (S.P. Abbott) S.P. Abbott *comb. nov.*

≡*Helvella* section *Silvicolae* S.P. Abbott, 1988, in Abbott and Currah, Mycotaxon 33: 245.

=*Wynnella* Boudier, 1885, Bulletin de la Société Mycologique de France 1: 102.

Type Species: *Helvella silvicola* (Beck) Harmaja, 1974, Karstenia 14: 103. (Monotypic).

Ascocarp: subsessile to indistinctly stipitate; apothecium auriculoid (erect, elongate, one-sided, reminiscent of a rabbit's ear); hymenium dark purplish red brown, smooth to slightly rugose; excipular surface red brown, glabrous; stipe indistinct, glabrous, shallowly fluted, sulcate and solid or becoming sparingly chambered; odour strong in dried specimens. **Asci**: pleurorhynchous. **Ascospores**: 19-24 x 14-17 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate, with large, central, broadly ellipsoidal guttule.

Notes: *Helvella silvicola* is frequently maintained in the monotypic genus *Wynnella* on the basis of apothecial structure, coloration, excipular vestiture and flesh consistency (e.g., Dissing 1972). Ascospore morphology (Fig. 51) and excipulum anatomy suggest placement of this taxon in *Helvella*, but other characters warrant recognition of the monotypic subgeneric section proposed by Abbott and Currah (1988)(see notes under *H. silvicola*).

Helvella silvicola (Beck) Harmaja, 1974, Karstenia 14: 103.

≡*Otidea silvicola* Beck, 1889, in Saccardo Sylloge Fungorum omnium hucusque cognitarum 8: 97.

≡*Wynnella silvicola* (Beck) Nannfeldt, 1966, Annales Botanici Fennici 3: 309.

=*Otidea auricula* auct. (see Kanouse 1949); non Schaeffer (*fide* Harmaja 1974).

(additional synonyms see Eckblad 1968; Abbott and Currah 1988)

Type Material: unknown.

Figs. 4a-c, 27, 51.

Apothecium: 5-23 mm diam., 10-60 mm high (up to 50 x 80 mm fresh), auriculoid or rarely irregularly cupulate with one enlarged lobe, margin inrolled initially, expanding and rarely somewhat reflexed in age, hymenium dark purplish red brown to dark brown fresh, when dry blackish brown, smooth or rarely slightly undulate-rugose in extreme age, excipular surface medium red brown or pale red brown to white near base, glabrous. **Stipe**: 2-10 x 2-9 mm (up to 8 x 20 mm fresh), tapered to base or nearly equal, yellow brown to pale yellow or white at base, shallowly fluted or ribbed, sulcate and solid or with central chamber. **Asci**: 200 x 15-19 µm, pleurorhynchous. **Paraphyses**: 5-6 µm diam. at apex, clavate, brown, contents finely granular. **Ascospores**: 17-24 x 11.5-17 µm, broadly ellipsoidal, hyaline, smooth, with SEM finely rugose, uniguttulate.

Habitat: Solitary to gregarious or scattered and numerous on duff, rarely in burned areas, under conifers. Associated trees: *Picea glauca, Picea engelmannii, Picea mariana, Pinus contorta, Pinus ponderosa, Abies lasiocarpa,* and *Larix laricina*. Associated shrubs: *Salix discolor, Shepherdia canadensis, Symphoricarpos* sp., *Amelanchier alnifolia*, and *Rosa* sp. Fruiting from June 5 to September 22 in AB. July and August collections are common.

Distribution: Widely distributed throughout boreal and montane regions from AK, YT, BC, AB, MB and MT. Reported from ID and WA (Larsen and Denison 1978, as *Wynnella silvicola*). Also in eastern North America (Huhtinen 1985; Kanouse 1949, as *Otidea auricula*), Europe (Harmaja 1974a; Cannon *et al.* 1985) and Asia (Dissing and Raitviir 1974, as *Wynella silvicola*). Map 16.

Notes: This species has been placed in the monotypic genus *Wynnella* Boudier (Dissing 1966b, 1972; Eckblad 1968; Larsen and Denison 1978). Ascospore morphology (size, shape, ornamentation and guttulation) and excipulum anatomy, which are primary defining characters in the genus *Helvella*, are comparable to other *Helvella* species. The slightly to distinctly fluted or ribbed stalk, which may be elaborately infolded or somewhat chambered in some specimens (Fig. 4a,c), is an additional character linking this species with *Helvella*. Stipe morphology is similar in *H. silvicola* and *H. leucomelaena* (q.v.) (compare Figs. 3a and 4a,c). The species is distinctive in having a reddish brown, auriculoid ascocarp with a glabrous excipulum. Dried ascocarps are horny in consistency and are difficult to rehydrate in water or KOH. Dried specimens also have a unique strong odour (although none was detected in fresh collections).

The most similar species are in subgenus *Leucomelaenae*. *Helvella leucomelaena* and *H. aestivalis* (q.v.) rarely have the one sided lobe. *Helvella aestivalis* is also the only other species in the genus which has reddish pigmentation. They can be easily distinguished on the basis of excipular surface vestiture, ascospore size and shape, and habitat. Other species with a glabrous excipular surface include *H. lacunosa* (q.v.) and *H. lactea* (q.v.) in the subgenus *Helvella*, and *H. elastica* (q.v.) and *H. atra* (q.v.) in the subgenus *Elasticae*.

Collections Examined: CANADA: Yukon: Carmacks, Ziller 08 4 1962, DAVFP 14359, DAOM 93065. **British Columbia**: Kindersly Creek, Kootenay N.P., Rushton 06 16 1969, UVIC; Bull River winter range, east Kootenays, Paden spring 1976, UVIC. **Alberta**: Winfield, Strand 07 8 1975, ALTA 7341; Astoria River valley, Jasper N.P., Currah 07 25 1988, ALTA 8312; Highwood Pass, Jasper N.P., Currah 07 15 & 23 1983, ALTA 8277, 8278; Fryatt valley, Jasper N.P., Richardson (SA 300) 09 22 1989, SA; Athabasca River valley, 14 km from Sunwapta falls, Jasper N.P., Abbott (SA 371) 08 2 1990, SA; Fish Lake near Nordegg, Abbott (SA 379),08 3 1990, SA; Fish Lake near Nordegg, Abbott 07 16 1987, ALTA 8272; 30 km east of Nordegg, Abbott (SA 1150) 06 13 1996, SA; 50 km west of Rocky Mountain House, Abbott 07 27 1987, ALTA 8273; Raven Fish Hatchery near Caroline, Abbott 07 6 1980, ALTA 8284; Red Deer River valley on Forestry Trunk road, Abbott 07 18 1988, UAMH M552; above Lake Louise, Banff N.P., Ostafichuk 08 3 1965, ALTA 605; Sawback range Mount Ishbell, Banff N.P., Rushton 09 5 1968, UVIC; Bow Valley P.P., Abbott (SA 750) 06 5 1993, SA. **Manitoba**: east end of Whitemud Lake, Parker 07 6 1971, DAOM 134578. **Québec**: Manitounuk Islands, Poste-de-la-Baleine area, Huhtinen, 07 1982, TUR 78781. **USA**: **Alaska**: Forest Nature trail, Glacier Bay National Monument, Cooke 07 9 & 11 & 20 & 27 1980, WSP 67850, MU F35984, F36302, 36347; Bartlett Cove, Glacier Bay National Monument, Cooke 07 6 1978, 08 28 1979, 06 20 1980, DAOM 179108, 179112, MU F36557. **Montana**: Echo Lake, Flathead National Forest, Cummins 07 31 1928, MICH. **RUMANIA**: Lacul Rosu, dist. Harghita, Toma 06 16 1961, K.

Underwoodia Peck, 1890, Annual Report. New York State Museum 43: 32.

=*Geomorium* Spegazzini, 1922, Anales de la Sociedad Científica Argentina 94: 79.

Type Species: *Underwoodia columnaris* Peck, 1890, Annual Report. New York State Museum 43: 32.

Macroscopic Features: ascocarp epigeous, stipitate; apothecium appressed to upper portion of stipe, apothecial margin entirely fused to stipe; hymenium pallid to brown, longitudinally wrinkled to undulate-rugose; excipular surface indistinct and merging with stipe; stipe cylindrical, white, pubescent, highly ribbed and lacunose, internally highly chambered. **Microscopic Features**: ascospores broadly ellipsoidal, hyaline, nodulose-warted, with large, isolated, broadly rounded warts of unequal size, nonapiculate, uniguttulate, tetranucleate; asci operculate, pleurorhynchous; paraphyses clavate, enlarged gradually to apex, hyaline, contents finely granular; apothecial tissue in cross section divided distinctly into ectal and medullary layers, ectal excipulum of *textura angularis*, medullary excipulum of *textura intricata*.

Underwoodia columnaris Peck, 1890, Annual Report. New York State Museum 43: 32.

≡*Helvella columnaris* (Peck) Eckblad, 1968, Nytt Magasin Botanikk 15: 91.

Type Material: Type material at NY listed by Eckblad (1968).

Figs. 12, 42.

Apothecium: 5-20 mm diam., 55-160 mm high, appressed to upper portion of stipe, rarely covering entire stipe surface, excipular surface and margin entirely fused to stipe surface, hymenium when dried orange brown to red brown or medium brown (pallid to cream when fresh), longitudinally folded-wrinkled, undulate-rugose, surface often cracking. **Stipe**: 60-130 x 5-30 mm, equal, when dried white to cream, pubescent, highly ribbed and lacunose, base often folded-fluted, internally highly chambered. **Asci**: 300-400 x 14.0-20 μm, pleurorhynchous. **Paraphyses**: 4.0-6.0 μm diam. at apex, clavate, enlarged gradually to apex, hyaline. **Ascospores**: 18.8-22.1 x 11.8-13.7 μm, broadly ellipsoidal, hyaline, verrucose to nodose or smooth when immature, with SEM warts large, isolated, broadly rounded; typically uniguttulate, rarely aguttulate or biguttulate.

Habitat: Solitary or gregarious on soil or leaf litter in deciduous woods. Fruiting from July 10 to August 1 in MB.

Distribution: Rare in boreal regions in the eastern portion of the study area from MB. Also in eastern North America (Seaver 1928, 1942; Jensen 1977). This species is endemic to eastern North America extending into the study area only in the extreme south east. Map 23.

Notes: This species is close to *U. beatonii* (q.v.) and *U. fuegiana* (q.v.) from Australia and Argentina respectively. *U.nderwoodia columnaris* is distinguished by its smaller ascospores. Excipulum structure is similar between *U. columnaris* and *U. fuegiana*, but is distinct from that in *U. beatonii* (Rifai 1968)(see also notes under *U. beatonii*).

Collections Examined: CANADA: Manitoba: east Manitoba Agricultural College, Winnipeg, Bisby 07 13 1927, 07 28 1928, DAOM 206822, 206823; Manitoba Agricultural College, Winnipeg, Bisby 08 1 1927, DAOM 154831; Red River, south Manitoba Agricultural College, Winnipeg, Bisby 08 1 1928, DAOM 1080, 206824; Winnipeg, Bisby 07 10 1932, K. **USA: Michigan**: Middle Maple River, A.H. Smith & Stuntz (Stz 2800) 07 15 1947, WTU.

Extralimital Species

Underwoodia beatonii Rifai, 1968, Verhandelingen der Koninklijke Nederlandse Akademie van Wetenschappen, Afd. Natuurkunde II, 57(3): 69.

≡*Helvella beatonii* (Rifai) Harmaja, 1974, Karstenia 14: 103.

Type Material: Holotype K, examined.

Distribution: Known only from Australia (Rifai 1968).

Notes: It is distinguished from *U. columnaris* (q.v.) by its larger ascospores (22.7-25.4 μm excluding ornament in *U. beatonii*). *Underwoodia beatonii* differs from both *U. columnaris* and *U. fuegiana* (q.v.) in its thin ectal excipulum layer, broader hyphae of the medullary excipulum, and presence of large nematode-like cells in the medullary excipulum (Rifai 1968).

Collections Examined: AUSTRALIA: Anglesea campground, Victoria, Beaton (215) 07 18 1964, K (holotype).

Underwoodia fuegiana (Spegazzini) Gamundí, 1957, Darwiniana 11: 419.

≡*Geomorium fuegianum* Spegazzini, 1922, Anales de la Sociedad Científica Argentina 94: 79.

≡*Helvella fuegiana* (Spegazzini) Eckblad, 1968, Nytt Magasin Botanikk 15: 92.

Type Material: unknown.

Distribution: Known from South America (Gamundí and Horak 1979).

Notes: Close to the other two species examined, but differs in geographic distribution and morphology (see notes under *U. columnaris* and *U. beatonii*). Specimens of *U. singeri*, also described from South America (Gamundí and Horak 1979) were not examined.

Collections Examined: ARGENTINA: Nahuel Huapi, Gilbert 1949, K spirit collection 191.

Tribe: genera *incertae sedis*

Hydnotrya Berkeley & Broome, 1846, Annals and Magazine of Natural History 18: 78.

=*Geoporella* Soehner, 1951, Zeitschrift für Pilzkunde 8: 8. (*fide* Trappe 1975a).

=*Gyrocratera* Hennings, 1899, Verhandlungen Botanischer Verein der Provinz Brandenburg 41: 9. (*fide* Trappe 1975a).

Type Species: *Hydnotrya tulasnei* (Berkeley) Berkeley & Broome, 1846, Annals and Magazine of Natural History 18: 78.

Macroscopic Features: ascocarp hypogeous, sessile, irregularly globose to ellipsoidal, often somewhat dorsoventrally flattened, irregularly lobed and convoluted; hymenium enclosed within infolded chambers, may be exposed through base or external opening, internally hollow or sparsely to highly infolded and chambered; excipular surface shades of brown, glabrous to pubescent; stipe absent. **Microscopic Features**: ascospores broadly ellipsoidal to globose, brown, hyaline when immature, nodulose-verrucose, punctate, to echinulate, nonapiculate to apiculate, aguttulate to uniguttulate, de Bary bubbles absent or present in small proportion of mature spores, tetranucleate; asci clavate to cylindrical, tapered to base, hyaline, indehiscent, containing eight uniseriate to irregularly clustered ascospores; paraphyses filiform to clavate, enlarged gradually to apex, hyaline, contents finely granular; tissues in cross section separated into medullary excipulum of *textura intricata* and ectal excipulum of *textura angularis* or *textura prismatica*.

Key to subgenera of *Hydnotrya*

1. Ascospore wall smooth with amorphous, irregularly thickened to nodulose epispore.. **subgen. *Hydnotrya***

1'. Ascospore wall echinate.................................... **subgen. *Cerebriformae*** .... **(*H. cerebriformis*)**

Hydnotrya Subgenus *Hydnotrya*

Type Species: *Hydnotrya tulasnei* (Berkeley) Berkeley & Broome, 1846, Annals and Magazine of Natural History 18: 78.

Ascocarp: hypogeous to erumpent, sessile, irregularly globose to ellipsoidal or irregularly lobed; hymenium enclosed or exposed at base or through localized openings, internally hollow to sparingly or highly chambered. **Ascospores**: globose to broadly ellipsoidal, brown at maturity, wall smooth, becoming irregularly thickened over entire spore surface from adhering amorphous epispore, surface irregular, punctate or often nodulose, with large, isolated, broadly rounded warts, thick polar regions (appearing as apiculi) present or absent, uniguttulate to aguttulate, de Bary bubbles absent or present in small proportion of mature spores.

Notes: The type subgenus includes species with irregularly thickened to nodulose, globose to broadly ellipsoidal ascospores (Figs. 59-62).

Key to species of *Hydnotrya* subgenus *Hydnotrya*

1. Ascospores (epispore) distinctly nodulose at maturity.................................. 2
1'. Ascospores (epispore) irregularly thickened to punctate at maturity...................3
    2. Ascospores globose to subglobose......................................***H. tulasnei***
    2'. Ascospores ellipsoidal to broadly ellipsoidal..........................***H. michaelis***
3. Ascospores (epispore) at maturity cylindrical, surface irregularly rugose, with large apical thickenings often appearing as depressed apiculi...***H. cubispora***
3'. Ascospores at maturity broadly ellipsoidal, surface roughened to punctate, nonapiculate..***H. variiformis***

Hydnotrya cubispora (Bessey & B.E. Thompson) Gilkey, 1939, Oregon State Monographs, Studies in Botany 1: 23.

≡*Genea cubispora* Bessey & B.E. Thompson, 1920, Mycologia 12: 284.

Type Material: Isotype MICH, examined, isotype OSC, ?holotype MSC.

Figs. 16, 59, 60.

Ascocarp: 6-33 mm diam., 5-22 mm high, irregularly lobed, subglobose to ellipsoidal, excipular surface (exterior) pallid grey brown to light brown or orange brown to red brown dried, pubescent to glabrous, undulate-rugose, margin entirely fused (enclosed) or open at base, internally highly convoluted, chambered, with some closely appressed folds and large open chambers (rarely a single large chamber), chambers white, felty-pubescent. Stipe absent. **Asci**: 25-35 μm diam., cylindrical. **Paraphyses**: 6.9-11.6 μm diam. at apex, clavate, hyaline, contents finely granular. **Ascospores**: 42.8-53.6 x 29.1-36.0 μm, broadly ellipsoidal to subglobose, brown at maturity from wall pigmentation, hyaline when immature, epispore thickening by maturity resulting in cylindrical spores which may appear subrectangular or 'cuboidal', often with an irregularly thickened wall with the surface irregularly undulate rugose or slightly nodose with SEM, epispore extensively thickened at poles when mature giving the appearance of large cupulate apiculi, apiculi often striate on inner surface.

Habitat: Hypogeous or in rotted wood, solitary to gregarious in soil or rotted woody debris in coniferous woods. Associated trees: *Picea sitchensis*, *Pinus monticola*, *Pseudotsuga menziesii, Tsuga heterophylla*, and *Tsuga* sp. Fruiting from September 12 in WA to November 8 in BC.

Distribution: Uncommon in montane and coastal regions from AK, BC, and WA. This species is newly reported from BC. Also distributed in eastern and southern North America (Gilkey 1939; Miller and Miller 1982). British collections at Kew (examined with B. Spooner) are the first reports from Europe (in Pegler *et al.* 1993). Map 24.

Notes: This species is included in the type subgenus on the basis of the irregularly thickened epispore which may become inconspicuously nodulose. This feature suggests a closer relationship with *H. tulasnei* (q.v.) and *H. michaelis* (q.v.) than to *H. cerebriformis* (q.v.) of the subgenus *Cerebriformae*. Also, ascocarp morphology and colour are similar. *Hydnotrya cubispora* is easily distinguished by its cylindrical, apically thickened spores that have large cupulate apiculi when mature. The concept of this taxon has been somewhat confused since its original description in which the ascospores were said to be cuboidal or polygonal. Examination of the isotype (MICH) revealed that the description is based on immature and submature specimens which lack apiculi on most spores. Spore measurements reported above were taken only from mature ascospores and are considerably larger than in the original description (27-42 x 24-28 µm in Bessey and Thompson 1920) due to degree of epispore thickening. Gilkey (1954) recognized that early descriptions had been based on immature specimens, and stated that the spore ornamentation is not papillate, but irregularly thickened with the thickenings sometimes resulting in unusually elongated spores in the apical region of the ascus. Apical thickening of the spore wall precedes apiculus development. The collections from the United Kingdom were likely introduced with nursery stock of *Picea sitchensis* and Trappe (1971) lists this species as mycorrhizal with conifers. One specimen (IMI 311325) was somewhat atypical but was presumed to be an immature *H. cubispora*. It should be reexamined in light of the recently described *H. confusa* (Spooner 1992; Pegler *et al.* 1993).

Collections Examined: CANADA: British Columbia: Forest Nursery at Haney, Bandoni (Stz 13359) 11 8 1965, WTU. **Québec**: south of Chigoubiche River, Lac St. Jean Ouest Co., Redhead 09 4 1976, DAOM 160752; St. Donat, Montcalm Co., Rousseau 1965, DAOM 197990; Parc de la Gatineau, Chemin du Lac Lapêche, Dalpé 07 30 1985, DAOM 197989. New Brunswick: Moore's Falls, Kings Co., Harrison 08 1 1953, DAOM 143006; Glenmont, Harrison 10 10 1952, DAOM 111849; Casey's Corner, Harrison 10 12 1952, DAOM 111848. **USA: Alaska**: Girdwood, Kempton 09 18 1969, WK 4288; Turnagain Pass on Seward highway, Kempton 10 21 1963, WK 3033. **Washington**: the Pines, Copalis, Roger (Stz 20390) 09 24 1978, WTU; the Pines, Copalis, Stuntz (Stz 20629) 09 12 1979, WTU, K; near Copalis, SDL-B (SLB 1523) 09 24 1978, WTU, K; Troublesome Creek, Stuntz (Stz 20389) 09 25 1978, WTU, K. **Michigan**: between Bass and Little Bass Lakes, Cisco Lake Chain, Gogebic Co., Bessey & Darlington (123) 08 14 1919, MICH (isotype). **West Virginia**: Canaan valley, Tucker Co., Cooke 08 3 1985, WSP 68005. **UNITED KINGDOM:** Scotland, Dumfries and Galloway, Forest of Ae, Redfern 10 1 1975, K ex E; Scotland, Grampian, Durris, Mintbrae, Alexander 10 12 1982, K ex E; Soudley Ponds, Gloucestershire, Clark 08 16 1986, IMI 311325.

Hydnotrya michaelis (E. Fischer) Trappe, 1975, Mycotaxon 2: 113.

≡*Geopora michaelis* E. Fischer, 1898, Hedwigia 37: 59.
=*Hydnotrya ploettneriana* (Hennings) Hawker, 1974. Transactions of the British Mycological Society 63: 68. (authentic material K, examined).
=*Hydnotrya yukonensis* Gilkey, 1947, Mycologia 39: 445. (holotype DAOM, examined).
(additional synonyms see Trappe 1975a)

Type Material: Holotype TO.

Fig. 15.

Ascocarp: 13-18 mm diam., 8-10 mm high, irregularly globose, flattened, lobed, exterior surface pale brown to reddish brown dried, pubescent to glabrous, undulate-rugose, margin entirely fused (enclosed), internally highly convoluted and chambered, chambers white to cream, felty pubescent, odour strong when fresh. Stipe absent. **Asci**: 235-330 x 28.7-29.2 (38.6) µm, cylindrical. **Paraphyses**: 6.9-9.4 µm diam. at apex, clavate, enlarged gradually to apex, hyaline, contents finely granular. **Ascospores**: 27.5-33.0 x 20.5-25.5 µm, broadly ellipsoidal, brown, hyaline when immature, aguttulate or uniguttulate especially when immature, epispore surface nodulose, with SEM surface with large, isolated, broadly rounded warts, immature spores smooth.

Habitat: Solitary to gregarious in soil in mixed woods. Associated trees: *Picea glauca*, *Tsuga* sp., and *Alnus* sp. Fruiting from early July in YT to July 27 in AK.

Distribution: Rare in montane and coastal regions from YT and AK. Also distributed in Colorado (Fogel and Trappe 1976), Europe (Kers 1989; Vries 1981; Patouillard 1925; Teudorowiczc 1928, as G*eopora michaelis*) and Asia (Cao 1988). A map of global distribution is provided in Kers (1989). Map 25.

Notes: Close to *H. tulasnei* (q.v.), which has similar ascospore ornamentation. *Hydnotrya michaelis* has paler ascocarps, larger lobes and internal chambers, and broadly ellipsoidal ascospores. *Hydnotrya cubispora* (q.v.) is macroscopically similar, but easily differentiated by its irregularly thickened cylindrical epispore which often appears apiculate.

Collections Examined: CANADA: Yukon: near Potato Hills, Mayo Landing, Broadfoot early 07 1943, DAOM 14081 (holotype of *H. yukonensis*). **USA: Alaska**: near Hope, Kempton 07 27, WK 3028. **UNITED KINGDOM**: Soudley Ponds near Littledean, Gloucestershire, Francis 05 23 1981, IMI 259183, 259184. **GERMANY**: Engel (415) 07 14 1974, K; Plöttner (1325) 05 1900, K. **AUSTRIA:** Mähr-Weisskirchen, Petrak 08 1929, WSP 31544.

Hydnotrya tulasnei (Berkeley) Berkeley & Broome, 1846, Annals and Magazine of Natural History 18: 78.

≡*Hydnobolites tulasnei* Berkeley, 1844, Annals and Magazine of Natural History 13: 340-360.

=*Hydnotrya carnea* (Corda) Zobel, in Corda 1854. Icones fungorum hucusque cognitorum 6: 1-91. (authentic material K, examined).

=*Hydnotrya intermedia* (Bucholtz) Soehner. 1942. Notizblatt des Botanischen Gartens und Museums zu Berlin 15: 762-782. (*fide* Gilkey 1954).

(additional synonyms see Gilkey 1954).

Type Material: Holotype K; authentic material K, examined.

Fig. 61.

Ascocarp: 10-18 mm diam., 8-16 mm high, irregularly globose to subglobose, margin entirely fused (enclosed), excipular (exterior) surface red brown to dark red brown dried, glabrous, undulate-rugose, internally highly convoluted and chambered, chambers white to pallid, felty pubescent. Stipe absent. **Asci**: 300-340 x 26-36 µm, cylindrical to clavate (especially when immature). **Paraphyses**: 5-6 µm diam. at apex, clavate, enlarged gradually to apex, hyaline, contents finely granular. **Ascospores**: 26.8-34.3 x 25.5-33.2 µm globose to subglobose, brown at maturity, hyaline when immature, uniguttulate to aguttulate, epispore surface nodulose, with SEM surface with broadly rounded warts.

Habitat: Hypogeous, solitary or gregarious in duff or rotted wood under conifers. Associated trees: *Pinus contorta, Pseudotsuga menziesii*, and *Tsuga heterophylla*. Fruiting from June 20 to 27 in OR.

Distribution: Rare in montane regions from OR (see also Fogel 1974). Also distributed in eastern North America (Gilkey 1954), Europe (Lange 1956), and Asia (Trappe 1976; Cao 1988). Map 24.

Notes: This species is characterized by dark red brown excipulum, highly convoluted and infolded interior, and globose to subglobose, nodulose ascospores. It is most closely related to *H. michaelis* (q.v.), but is separated on colour, degree of infolding, and ascospore shape (see also notes under *H. michaelis*). Ascospore ornamentation is very similar between the two species. Gilkey (1954) discusses the variation in specimens with clavate to cylindrical asci, and synonymizes *H. carnea* and *H. intermedia* with *H. tulasnei*.

Collections Examined: USA: Oregon: southwest of Bend near Mount Bachelor, Egger (1135) 06 27 1984, DAOM 199694; near Bend, Miller (SM 745) 06 20 1984, WTU. **Michigan**: Tahquamenon Falls State Park, A.H. Smith 08 28 1951, DAOM 178576. **New York**: near Twin Ponds, Star Lake, Rosenthal 08 9 1974, DAOM 148902. **UNITED KINGDOM**: Woodbury Castle, Devon, Roberts 08 9 1986, IMI 311344; Westwood, Malborough, Wiltshire, Wright 08 15 1987, IMI

318223; Collingbourne Wood, Hampshire, Fletcher 08 16 1987, IMI 318214. **DENMARK**: Elsehoved, Fyn, Lange (3082) 08 11 1949, K. **NETHERLANDS**: De Steeg Prov. Felderland, Bas (1055) 08 7 1956, K. **CZECHOSLOVAKIA**: Prague, Corda, Herbarium Berkeley 1879, K; Bohemia, Bubák 08, IMI 11956. **Exsiccata:** Sydow, Mycotheca germanica, Schlesien, bei Krummhübel, Riesengebirge, Germany, Sydow 08 17 1922, s.n. *Hydnotrya carnea*, K; Sydow, Mycotheca germanica, Schlesien, Grenzdorf bei Schwarzbach, Isergebirge, Germany, Sydow 07 28 1922, s.n. *Hydnotrya carnea*, K; Petrak, Mycotheca generalis, 433, Steiermark, Mürzzuschlag, Mitterdorf, Keissler 07 06 1940, s.n. *Hydnotrya tulasnei*, WSP AS18300.

Hydnotrya variiformis Gilkey, 1947, Mycologia 39: 444.

Type Material: Holotype OSC.

Figs. 17, 62.

Ascocarp: 4-19 mm diam., 5-10 mm high (up to 40 mm diam. fresh), irregularly lobed, globose to subglobose, typically flattened, margin entirely fused or with basal opening, excipular surface pallid to pale yellow brown or orange brown to dark red brown dried, pubescent, internally hollow or highly convoluted and chambered, chambers white to cream, felty pubescent. Stipe absent. **Asci**: 258-264 x 26-29 µm, cylindrical. **Paraphyses**: 5.8-10.5 µm diam., nearly equal to clavate, enlarged gradually to apex, hyaline, contents finely granular. **Ascospores**: 28.5-36.6 x 18.0-28.7 µm, broadly ellipsoidal, yellow brown at maturity, hyaline when immature, aguttulate or uniguttulate especially when immature, with large central globose oil guttule, de Bary bubbles present in small proportion of mature spores, epispore surface verruculose to punctate, with SEM surface appearing punctate and with small irregular nodulose wall thickenings.

Habitat: Hypogeous in woody debris or embedded in rotted wood, solitary to gregarious in coniferous woods. Associated trees: *Abies lasiocarpa* and *Tsuga mertensiana*. Fruiting from July 28 to August 22 in ID.

Distribution: Infrequent in montane and coastal forest regions from AK, BC, ID, OR, and WY. Reported also from Washington (Trappe pers. comm.). This species is endemic to north west North America. It is newly reported for BC and AK, significantly extending its range to the north, and it is distributed south of the study area in California. Map 24.

Notes: Spore ornamentation is less developed than other species in the subgenus, but is irregularly thickened and slightly nodulose at maturity. The punctate spores are unique in the genus. Some specimens are distinctly yellow, especially when immature. All collections are from rotted wood (or no annotation of substratum was provided), while other species in the genus are frequently collected from soil. This species is similar to *H. michaelis* (q.v.) in spore shape and size but *H. variiformis* lacks the well developed nodulose epispore surface. *Hydnotrya cerebriformis* (q.v.) is similar in having de Bary bubbles in a small proportion of mature spores (see also notes under *H. cerebriformis*).

Collections Examined: **CANADA: British Columbia:** Port Renfrew, Vancouver Island, Dorworth 05 16 1988, DAVFP 23631. **USA: Alaska**: near Hope, Kempton 07 28 1968, WK 3016. **Idaho**: Brundage, Hawker 08 2 & 8 1962, K; Brundage road, Hawker 08 22 1962, K. **Oregon**: Three Creek Lake southwest of Sisters, Deschutes Co., Fogel (1174) 08 20 1976, DAOM 178574, K. **Wyoming**: Medicine Bow Mountains, Carbon Co., Binegar 08 10 1950, WSP 28610, MU F35625. **California**: Sisson Southern trail, Mount Shasta, Cooke 06 27 1947, WSP 39119; Panther Creek Meadows, Mount Shasta, Cooke 07 1 1951, WSP 30042; horse camp area, Mount Shasta, Cooke 08 17 1962, 07 18 1966, WSP 55752, 58743.

Hydnotrya Subgenus *Cerebriformae* S.P. Abbott *subgen. nov.*

Ascocarpae hypogaea, subglobosa, caverna fere simplice aut gleba compactis plicis composita; ascosporae globosa, echinatae.

Type Species: *Hydnotrya cerebriformis* Harkness, 1899, Proceedings of the California Academy of Sciences, Series 3, Botany 1: 266. (monotypic).

Ascocarp: hypogeous to erumpent, sessile, irregularly lobed, globose to ellipsoidal, typically flattened, margin fused (enclosed) or with basal opening; exterior surface pallid yellow or orange brown to dark red brown, pubescent to glabrous; internally highly convoluted and chambered, chambers white, felty-pubescent. **Ascospores**: globose to broadly ellipsoidal, brown at maturity, hyaline when immature, thin-walled and smooth when immature, becoming thick-walled at maturity, aguttulate or uniguttulate especially when immature, with large central subglobose oil guttule, de Bary bubbles in a small proportion of mature spores, appearing warted to echinulate, with SEM surface covered with numerous long pointed spines, but often appearing warted or cracked from adhering debris and clumping of spines.

Notes: This monotypic subgenus is established on the basis of the globose, echinate ascospores of *H. cerebriformis* (Figs. 63, 64). The isolated taxonomic position of this species was noted by Trappe (1979).

Hydnotrya cerebriformis Harkness, 1899, Proceedings of the California Academy of Sciences, Series 3 Botany 1: 266.

=*Hydnotryopsis suevica* Soehner, Notizblatt des Botanischen Gartens und Museums zu Berlin 15: 779. (*fide* Trappe 1975a).

≡*Geoporella suevica* (Soehner) Soehner, 1951, Zeitschrift für Pilzkunde 8: 8.

Type Material: Holotype BPI.

Figs. 28, 63, 64.

Ascocarp: 8-24 mm diam., 8-13 mm high (up to 50 mm diam. fresh), irregularly lobed, globose to broadly ellipsoidal, typically flattened, margin fused or with an opening at base, excipular surface pale orange brown to dark red brown dried, pubescent to glabrous, undulate-rugose, internally highly convoluted and chambered, chambers white to cream, felty pubescent. Stipe absent. **Asci**: 260-370 x 26.8-36.8 µm, cylindrical or rarely somewhat clavate. **Paraphyses**: 6.6-11.1 µm diam. at apex, terminal cell 45-50 µm long, clavate, enlarged gradually to abruptly at apex, hyaline, contents finely granular. **Ascospores**: 26.1-32.8 x 24.2-27.8 µm, globose, subglobose, or broadly ellipsoidal, brown at maturity, hyaline when immature, aguttulate or uniguttulate especially when immature, appearing echinate, warted or verrucose, with SEM surface covered with numerous, long, pointed spines, but often appearing warted or cracked due to adhering matrix.

Habitat: Hypogeous to erumpent, solitary to gregarious in soil and litter in coniferous woods. Associated trees: *Picea engelmannii*, *Picea sitchensis, Pinus* sp., and *Abies* sp. Fruiting from July 29 to September 20 in AK.

Distribution: Infrequent in montane and coastal regions from AK and ID. This species is newly reported from AK and greatly extends the northerly range. Also reported from OR (Trappe pers. comm.), south west North America (Gilkey 1916, 1939; Fogel and Trappe 1976), Europe (Soehner 1951, as *Geoporella suevica*) and Asia (Cao 1988). Map 25.

Notes: This species is distinct, and relationship to other *Hydnotrya* species is unclear. *Hydnotrya variiformis* (q.v.) has de Bary bubbles in mature ascospores, but *H. cerebriformis* differs in its globose to subglobose ascospores with prominent echinate ornamentation. In many cases, the spores have distinct spines or coalesced clumps of spines, but often the surface appears irregularly cracked. This is attributed to adhering perispore or mucoid material being stuck to the spines. Hawker (1968a; Hawker *et al.* 1967) shows that spore features of *Elaphomyces* are influenced by fruiting body age and rate of drying during preservation. This may also apply to this species since spore morphology resembles *Elaphomyces* species (Hawker *et al.* 1967; Hawker 1968a; Trappe 1976; Samuelson *et al.* 1987). The echinate spores are fundamentally different from the irregularly thickened ones of the other species of the genus and warrant recognition at the subgeneric level.

Collections Examined: USA: Alaska: Girdwood, Kempton 08 28 1973, WK 6037; Ptarmigan Creek campground, Kenai Peninsula, Kempton 09 9 1965, WK 3023, DAOM 178553, K; Chilkoot Lake near Haines, Kempton 09 20 1970, 09 16 1971, WK 4950, 5590; Juneau, Kempton 07 29 1966, WK 3022. **Idaho**: Upper Payette Lake, Valley Co., A.H. Smith (60171) 08 17 1958, K; Vulcan Hot Springs, South Fork of Salmon River, Valley Co., A.H. Smith (66207) 08 26 1962, K; Squaw Meadows, Valley Co., A.H. Smith (60274) 08 18 1958, DAOM 178552; Brundage Reservoir, A.H. Smith 08 18 1962, K.

Gymnohydnotrya B.C. Zhang & Minter, 1989, Mycological Research 92: 192.

Type Species: *Gymnohydnotrya australiana* B.C. Zhang & Minter, 1989, Mycological Research 92: 193.

Macroscopic Features: ascocarps hypogeous, sessile, irregularly lobed to subglobose; hymenium exposed at outer surface and regions on the internal surface; internally hollow to infolded and chambered; basal mycelial tuft present. **Microscopic Features**: asci indehiscent, cylindrical, hyaline; ascospores ellipsoidal, hyaline, with large central globose oil droplet and two to many smaller polar guttules, tetranucleate, appearing rough to verrucose, with SEM surface echinate, spines often with adhering extramatrical tissue forming irregular reticulum of coalesced spines (Zhang and Minter 1989b).

Extralimital Species

Gymnohydnotrya australiana B.C. Zhang & Minter, 1989, Mycological Research 92: 193.

Type Material: holotype K, examined.

Distribution: Known only from Australia (Zhang and Minter 1989).

Notes: This species is distinguished from the other two members of the genus, *G. echinulata* (q.v.) and *G. ellipsospora* (Cribb) B.C. Zhang and Minter, by its larger more echinate ascospores. Ascocarps of *G. australiana* are more highly infolded and chambered with internal hymenial surface in addition to hymenium covering the exterior surface. Due to the variation of infolding and resultant chambers seen in some *Hydnotrya* species, such as *H. variiformis* (q.v.), *H. cubispora* (q.v.), and *H. michaelis* (q.v.), this character is of dubious importance at the specific level. Ascospore size and ornamentation are also somewhat variable in other taxa of the family (see notes under *Hydnotrya* species).

Collections Examined: AUSTRALIA: Rye, Victoria, Keane 01 1984, K spirit collection 1032 (holotype).

Gymnohydnotrya echinulata (G.W. Beaton) B.C. Zhang & Minter, 1989, Mycological Research 92: 194.

≡*Sphaerozone echinulatum* G.W. Beaton, 1978, in Beaton & Weste, Transactions of the British Mycological Society 71: 165.

Type Material: Holotype MELU; authentic material K, examined.

Distribution: Known only from Australia (Beaton and Weste 1978, 1982).

Notes: see notes under *G. australiana.*

Collections Examined: AUSTRALIA: Little River near Alexandra, Victoria, Crichton (Beaton 314) 08 20 1965, K spirit collection.

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References Cited

Abbott, S.P. and R.S. Currah. 1988. The genus *Helvella* in Alberta. Mycotaxon 33: 229-250.

Abbott, S.P. and R.S. Currah. 1989. The larger cup fungi and other ascomycetes of Alberta. University of Alberta Devonian Botanic Garden, Edmonton.

Afzelius, A. 1783. Svamp-släget *Helvella*. Kongl. Vetensk. Akad. Nya Handl. 4: 299-313.

Anderson, P.J. and M.G. Ickis. 1921. Massachusetts species of *Helvella*. Mycologia 13: 201-229.

Beaton, G.W. and G. Weste. 1978. The genus *Sphaerozone*. Transactions of the British Mycological Society 71: 164-167.

Beaton, G.W. and G. Weste. 1982. Australian hypogaean ascomycetes. Transactions of the British Mycological Society 79: 455-468.

Benedix, E.H. 1965. *Acetabula costifera* (Lund. et Nannf.) n.c. in Thüringen. Westfälische Pilzbriefe 5: 113-116.

Benedix, E.H. 1969. Art- und gattungsgrenzen bei höheren Discomyceten, III (Specific and generic limits within higher Discomycetes). Die Kulturpflanze 17: 253-284.

Benedix, E.H. 1972. Art- und gattungsgrenzen bei höheren Discomyceten, IV. Die Kulturpflanze 19: 163-183.

Berthet, P. 1982. Sur la position taxonomique d'*Hydnotrya michaelis* (Fischer) Trappe (=*Geoporella michaelis* (Fischer) Soehner) (Ascomycétes). Bulletin de la Societé Mycologique de France 98: 75-79.

Bessey, E.A. and B.E. Thompson. 1920. An undescribed *Genea* from Michigan. Mycologia 12: 282-285.

Bosc, L. 1811. Mémoire sur quelques espèces de champignons des parties meridionales de l'Amérique septentrionale. Gesellschaft Naturforchender Freunde Berlin Sitzungsberichte 5: 83-89 + plates.

Boudier, E. 1885. Nouvelle classification naturelle des Discomycetes charnus. Bulletin de la Societé Mycologique de France 1: 91-121.

Boudier, E. 1907. Histoire et classification des Discomycètes d'Europe. p. 1-221. Paris.

Bregazzi, R. 1978. *Discina parma* Breitb. & Maas G. 1973 in Kassel gefunden. Beihefte zur Zeitschrift für Mykologie 44: 287-288.

Breitenbach, J. and F. Kränzlin. 1981 (English ed. 1984). Fungi of Switzerland, Volume 1: the Ascomycetes. Edition Mykologia, Lucerne.

Breitenbach, J. and R.A. Maas Geesteranus. 1973. Eine neue *Discina* aus der Schweiz. Proceedings. Koninklijke Nedelandse Akademie van Wetenschappen. Series C. Biological and Medical Science 76: 101-108.

Bresadola, G. 1881-1929. Fungi tridentini novi, vel nondum delineati 1: 1-114, 2: 1-118.

Brummelen, J. van. 1978. The operculate ascus and allied forms. Persoonia 10: 113-128.

Bulliard, P. 1780-1798. Herbier de la France, ou collection complette des plantes indigenes de ce Royaume; avec leurs détails anatomique, leurs propriétés, et leurs usages en medecine. Paris.

Callan, B.E. 1990. *Rhizina* root rot of conifers. Pest leaflet FPL56, Forestry Canada, Pacific and Yukon Region.

Calonge, F.D. and I. Arroyo. 1990. Notes on the genus *Helvella* in Spain. Mycotaxon 39: 203-217.

Calonge, F.D. and M. de là Torre. 1977. *Gyromitra tasmanica* (Berk.) Berk. & Cooke, new to Europe. Transactions of the British Mycological Society 68: 483-484.

Cannon, P.F., D.L. Hawksworth, and M.A. Sherwood-Pike. 1985. The British Ascomycotina. An annotated checklist. Commonwealth Mycological Institute, UK.

Cao, J.Z. 1988. The Helvellaceae in China with a discussion on its phylogeny. M.Sc. Thesis, Shanxi University, Taiyuan.

Cao, J.Z. and B. Liu. 1990. A new species of *Helvella* from China. Mycologia 82: 642-643.

Cao, J.Z., L. Fan and B. Liu. 1990. Some new species and new records of the genus *Helvella* from China II. Acta Mycologia Sinica 9: 184-190.

Cooke, M.C. 1878. Mycographia, seu icones fungorum 1: 179-214 + plates.

Cronquist, A. 1988. The Evolution and Classification of Flowering Plants. The New York Botanical Garden, New York.

Cummins, G.B. 1930. Montana Discomycetes from the Flathead National Forest. Papers of the Michigan Academy of Science, Arts and Letters 11:105-115.

Currah, R.S., L. Sigler, A. Flis, and S. Abbott. 1989. Cultural and taxonomic studies of ectomycorrhizal fungi associated with lodgepole pine and white spruce in Alberta. University of Alberta Microfungus Collection and Herbarium, Devonian Botanic Garden, Edmonton.

Denison, W.C. 1963. A preliminary study of the operculate cup-fungi of Costa Rica. Revista Biologia Tropical 11: 99-129.

Dennis, R.W.G. 1970. A fungus flora of Venezuela. Royal Botanic Gardens, Kew.

Dennis, R.W.G. 1978. British Ascomycetes, 2nd ed. J. Cramer, Vaduz.

Dissing, H. 1964. Studies in arctic and subarctic discomycetes. I. The genus *Helvella*. Botanisk Tidsskrift 60: 108-128.

Dissing, H. 1966a. A revision of collections of the genus *Helvella* L. ex St. Amans emend. Nannf. in the Boudier herbarium. Revue de Mycologie 31: 189-224 + plates.

Dissing, H. 1966b. The genus *Helvella* in Europe with special emphasis on the species found in Norden. Dansk Botanisk Arkiv 25: 1-172.

Dissing, H. 1972. Specific and generic delimitation in the Helvellaceae. Persoonia 6: 425-432.

Dissing, H. 1979. *Helvella papuensis*, a new species from Papua New Guinea. Beihefte zur Sydowia Annales. Mycologici Ser. II, 8: 156-161.

Dissing, H. 1983. *Helvella aestivalis* - a species with a true arctic-alpine-subalpine distribution. Agarica 4: 176-182.

Dissing, H. 1985. *Helvella aestivalis* - with notes on its edaphic conditions in arctic Canada. Agarica 6: 336-340.

Dissing, H. and M. Lange. 1967. Notes on the genus *Helvella* in North America. Mycologia 59: 349-360.

Dissing, H. and J.A. Nannfeldt. 1966. *Helvella cupuliformis* sp. nov., *H. villosa* (Hedw. ex O. Kuntze) comb. nov., *H. macropus* (Pers. ex Fr.) Karst., and their allies. Svensk Botanisk Tidskrift 60: 325-337.

Dissing, H. and A. Raitviir. 1974. Discomycetes of middle Asia. III. Otideaceae, Helvellaceae, Morchellaceae and Sarcoscyphaceae from the Tien-Shan mountains. Eesti NSV Teaduste Akadeemia Toimetised Köide Bioloogia 23: 104-111.

Dissing, H. and S. Sivertsen. 1980. Operculate discomycetes from Rana (Norway) 3. *Helvella rivularis* sp. nov. Botanisk Tidsskrift 75: 101-104.

Dodge, B.O. 1957. Oil drops and de Bary "bubbles" in ascospores. Bulletin of the Torrey Botanical Club 84: 431-441.

Donadini, J.C. 1975. Discomycètes operculés de Provence. Bulletin de la Société Linnéenne de Provence 28: 69-92.

Donadini, J.C. 1983. Étude des discomycètes (1) Criteres taxonomiques des Pezizales et Tuberales. Bulletin de la Société Linnéenne de Provence 35: 53-73.

Donadini, J.C. 1986a. Le genera *Discina* (*Gyromitra*) (2) Les éspèces connues - variabilité des caracteeres taxonomiques - scanning (Ascomycetes, Pezizales). Bulletin de la Société Linnéenne de Provence 38: 161-187.

Donadini, J.C. 1986b. Les Balsamiacees sont des Helvellaceae: cytologie et scanning de *Balsamia vulgaris* Vitt. et de *Balsamia platyspora* Berk. & Broome. Bulletin de la Societé Mycologique de France 102: 373-387.

Eckblad, F. 1968. The genera of the operculate Discomycetes. A re-evaluation of their taxonomy, phylogeny and nomenclature. Nytt Magasin Botanikk 15: 1-192.

Egger, K.N. and J.W. Paden. 1986a. Pathogenicity of postfire Ascomycetes (Pezizales) on seeds and germinants of lodgepole pine. Canadian Journal of Botany 64: 2368-2371.

Egger, K.N. and J.W. Paden. 1986b. Biotrophic associations between lodgepole pine seedlings and postfire ascomycetes (Pezizales) in monoxenic culture. Canadian Journal of Botany 64: 2719-2725.

Eriksson, O. E. and D.L. Hawksworth. 1989. Notes on Ascomycete systematics-Nos 804-888. Systema Ascomycetum 8: 59-65.

Eriksson, O.E. and D.L. Hawksworth. 1993. Outline of the Ascomycetes-1993. Systema Ascomycetum 12: 51-257.

Fitzpatrick, H.M. 1917. The development of the ascocarp of *Rhizina undulata* Fr. Botanical Gazette 63: 282-296.

Fogel, R. 1976. Ecological studies of hypogeous fungi. II. Sporocarp phenology in a western Oregon Douglas Fir stand. Canadian Journal of Botany 54: 1152-1162.

Fogel, R. and J.M. Trappe. 1976. Additions to the hypogeous mycoflora of Colorado. I. Ascomycetes. Mycotaxon 4: 211-217.

Fries, E.M. 1823. Systema Mycologicum 2:1-274. Lund.

Fries, E.M. 1849. Summa vegetabilium Scandinaviae p. 259-572.

Fries, E.M. 1871. Queletia, novum Lycoperdaceorum genus. Accedit nova Gyromitrae species. Öfvers. af Kongl. Vet.-Akad. Förhandl. 2: 171-174.

Fuckel, K. 1869. Symbolae mycologicae. Beiträge zur Kenntniss der rheinischen Pilze. Wiesbaden.

Gamundí, I.J. and E. Horak. 1979. Una nueva especie de *Underwoodia* de los bosques andinopatagonicos. Beihefte zur Sydowia 8: 162-167.

Gibson, J.L. and J.W. Kimbrough. 1988a. Ultrastructural observations on Helvellaceae (Pezizales). Ascosporogenesis of selected species of *Helvella*. Canadian Journal of Botany 66: 771-783.

Gibson, J.L. and J.W. Kimbrough. 1988b. Ultrastructural observations on Helvellaceae (Pezizales). II. Ascosporogenesis of *Gyromitra esculenta*. Canadian Journal of Botany 66: 1743-1749.

Gilkey, H.M. 1916. A revision of the Tuberales of California. University of California Publications in Botany 6: 275-356.

Gilkey, H.M. 1939. Tuberales of North America. Oregon State Monographs. Studies in Botany 1: 1-63.

Gilkey, H.M. 1947. New or otherwise noteworthy species of Tuberales. Mycologia 39: 441-793.

Gilkey, H.M. 1954. Taxonomic notes on Tuberales. Mycologia 46: 783-791.

Gillet, C. 1879. Champignons de France. Les Discomycètes. Alençon.

Ginns, J.H. 1968. *Rhizina undulata* pathogenic on douglas-fir seedlings in western North America. Plant Disease Reporter 52: 579-580.

Ginns, J.H. 1974a. *Rhizina* root rot: severity and distribution in British Columbia. Canadian Journal of Forest Research 4: 143-146.

Ginns, J.H. 1974b. *Rhizina undulata*. Fungi Canadenses 16. Biosystematics Research Institute, Ottawa.

Ginns, J.H. 1974c. *Discina macrospora*. Fungi Canadenses 39. Biosystematics Research Institute, Ottawa.

Ginns, J.H. 1974d. *Discina leucoxantha*. Fungi Canadenses 40. Biosystematics Research Institute, Ottawa.

Ginns, J.H. 1974e. *Gyromitra infula*. Fungi Canadenses 52. Biosystematics Research Institute, Ottawa.

Ginns, J.H. 1975. *Discina korfii*. Fungi Canadenses 68. Biosystematics Research Institute, Ottawa.

Graddon, W.D. 1976. Discomycete notes and records. Transactions of the British Mycological Society 66: 169-172.

Greuter, W., F.R. Barrie, H.M. Burdet, W.G. Chaloner, V. Demoulin, D.L. Hawksworth, P.M. Jørgensen, D.H. Nicolson, P.C. Silva, P. Trehane, and J. McNeil (eds.). 1994. International Code of Botanical Nomenclature (Tokyo Code). Regnum Vegetabile 131: 1-389.

Groves, J.W. 1962. Edible and Poisonous Mushrooms of Canada. Canada Department of Agriculture Pub. 1112, Ottawa.

Groves, J.W. and S.C. Hoare. 1953. The Helvellaceae of the Ottawa district. The Canadian Field-Naturalist 67: 95-102.

Groves, J.W. and S.C. Hoare. 1954. Notes on fungi from northern Canada. I. Hypocreales and Discomycetes. The Canadian Field-Naturalist 68: 1-8.

Häffner, J. 1987. Die Gattung *Helvella*: Morphologie und taxonomie. Beihefte zur Zeitschrift für Mykologie 7: 1-165.

Häffner, J. (English translation by H. Schalkwyk). 1991. Problems with defining species in *Helvella*. The Stinkhorn (Edmonton Mycological Club) 5: 37-39. (translated from Dutch in Coolia 32: 2-5, 1989).

Hallgrimsson, H. 1968. Icelandic species of the Helvellaceae. Flora Timarit um Islenzka Grasafraedi 6: 27-39.

Harkness, H.W. 1899. Californian hypogaeous fungi. Proceedings of the California Academy of Sciences 3rd Ser.: Botany 1: 241-293.

Harmaja, H. 1969a. A wider and more natural concept of the genus *Gyromitra* Fr. Karstenia 9: 9-12.

Harmaja, H. 1969b. A neglected species, *Gyromitra ambigua* (Karst.) Harmaja, n. comb., and *G. infula* s. str. in Fennoscandia. Karstenia 9: 13-19.

Harmaja, H. 1973. Amendments of the limits of the genera *Gyromitra* and *Pseudorhizina*, with the description of a new species, *Gyromitra montana*. Karstenia 13: 48-58.

Harmaja, H. 1974a. Notes on the genus *Helvella*, including the merging of the genus *Wynnella*. Karstenia 14: 102-104.

Harmaja, H. 1974b. Two new families of the Pezizales: Karstenellaceae and Pseudorhizinaceae. Karstenia 14: 109-112.

Harmaja, H. 1974c. Observations on the presence of a cyanophilic perispore in the spores of the Pezizales. Karstenia 14: 123-125.

Harmaja, H. 1974d. The generic limit between *Otidea* and *Tarzetta* (*Pustularia* auct.). Karstenia 14: 138-142.

Harmaja, H. 1976a. New species and combinations in the genera *Gyromitra*, *Helvella* and *Otidea*. Karstenia 15: 29-32.

Harmaja, H. 1976b. *Paradiscina* Benedix - a synonym of *Gyromitra* Fr. Karstenia 15: 33-35.

Harmaja, H. 1976c. Another poisonous species discovered in the genus *Gyromitra*: *G. ambigua*. Karstenia 15: 36-37.

Harmaja, H. 1976d. Scanning electron microscopy of the spores of *Gyromitra* subg. *Gyromitra* and subg. *Discina* (Pezizales). Karstenia 16: 6-9.

Harmaja, H. 1977a. A note on *Helvella solitaria* (syn. *H. queletii*) and *H. confusa* n. sp. Karstenia 17: 40-44.

Harmaja, H. 1977b. A revision of the *Helvella acetabulum* group (Pezizales) in Fennoscandia. Karstenia 17: 45-58.

Harmaja, H. 1978. New species and combinations in *Helvella* and *Gyromitra*. Karstenia 18: 57.

Harmaja, H. 1979a. Studies on cupulate species of *Helvella*. Karstenia 19: 33-45.

Harmaja, H. 1979b. Notes on *Gyromitra esculenta* coll. and *G. recurva*, a noteworthy species of western North America. Karstenia 19: 46-49.

Harmaja, H. 1981. *Helvella hyperborea* and *H. pedunculata* found in North America. Karstenia 21: 49.

Harmaja, H. 1982. *Helvella oblongispora* found in Finland. Karstenia 22: 20.

Harmaja, H. 1986. Studies on the Pezizales. Karstenia 26: 41-48.

Hawker, L.E. 1954. British hypogeous fungi. Philosophical Transactions Royal Society London 237: 429-546.

Hawker, L.E. 1955. Hypogeous fungi. Biological Reviews 30: 127-158.

Hawker, L.E. 1968a. Wall ornamentation of ascospores of species of *Elaphomyces* as shown by the scanning electron microscope. Transactions of the British Mycological Society 51: 493-498.

Hawker, L.E. 1968b. Hypogeous ascomycetes from Idaho. Journal of the Elisha Mitchell Scientific Society 84: 248-253.

Hawker, L.E. 1974. Revised annotated list of British hypogeous fungi. Transactions of the British Mycological Society 63: 67-76.

Hawker, L.E., J. Fraymouth and M. de la Torre. 1967. The identity of *Elaphomyces granulatus*. Transactions of the British Mycological Society 50: 129-136.

Hocevar, S. 1978. *Discina parma* Breitenb. & Maas G. (Helvellaceae, Ascomycetes) in some virgin forest nature reserves of Slovenia, Yugoslavia. Acta Botanica Croatia 37: 165-170.

Hocevar, S. 1982. New locality of *Discina parma* Breitenb. & Maas G. (Helvellaceae, Ascomycetes) in Yugoslavia. Acta Botanica Croatia 41: 129-131.

Holmgren, P.K., W. Keuken, and E.K. Schofield. 1981. Index Herbariorum Part 1 the herbaria of the world, 7th ed. Regnum Vegetabile 106: 1-452.

Holmskjøld, T. 1790. Beata ruris otia fungis danicis 2: 1-70 + plates.

Huhtinen, S. 1982. Ascomycetes from central and northern Labrador. Karstenia 22: 1-8.

Huhtinen, S. 1983. Finnish records of discomycetes: *Pseudorhizina sphaerospora* and *Poculum sydowianum*. Karstenia 23: 10-12.

Huhtinen, S. 1984. Additions to the ascomycetous flora of the Canadian North. Karstenia 24: 1-11.

Huhtinen, S. 1985. Mycoflora of Poste-de-la-Baleine, Northern Québec Ascomycetes. Le Naturaliste Canadien 112: 473-524.

Hutchison, L.J. 1989. Absence of conidia as a morphological character in ectomycorrhizal fungi. Mycologia 81: 587-594.

Hutchison, L.J., R.C. Summerbell and D.W. Malloch. 1988. Additions to the mycota of North America and Québec: arctic and boreal species from Schefferville, northern Québec. Le Naturaliste Canadien 115: 39-56.

Imai, S. 1932. Contribution to knowledge of the classification of Helvellaceae. The Botanical Magazine (Tokyo) 46: 172-175.

Imai, S. 1954. Elvellaceae Japoniae. Science Report Yokohama Nat. University 2: 1-35.

Jalkanen, R. and E. Jalkanen. 1981. Development of the fruit bodies of *Gyromitra esculenta*. Karstenia 21: 50-52.

Jalkanen, R. and J. Jalkanen. 1984. Autumnal nodules of *Gyromitra esculenta* photographed in the following spring. Karstenia 24: 12-13.

Jensen, R.D. 1977. Some stipitate Discomycetes of Iowa. Iowa State Journal of Research 52: 37-52.

Kanouse, B.B. 1946. Some studies in the genus *Helvella*. Papers of the Michigan Academy of Science, Arts and Letters 32: 83-90.

Kanouse, B.B. 1947. A survey of the Discomycete flora of the Olympic National Park and adjacent areas. Mycologia 39: 635-689.

Kanouse, B.B. 1949. Studies in the genus *Otidea*. Mycologia 41: 660-677.

Kar, A.K. and K.P. Pal. 1970. Some operculate discomycetes from west Bengal (India). Mycologia 62: 690-698.

Kempton, P.E. and V.L. Wells. 1970. Studies on the fleshy fungi of Alaska. IV. A preliminary account of the genus *Helvella*. Mycologia 62: 940-959.

Kempton, P.E. and V.L. Wells. 1973. Studies on the fleshy fungi of Alaska. VI. Notes on *Gyromitra*. Mycologia 65: 396-400.

Kennedy, J.R., R.W. Williams, and J.P. Gray. 1989. Use of Peldri II (a fluorocarbon solid at room temperature) as an alternative to critical point drying for biological tissues. Journal of Electron Microscopy Technique 11: 117-125.

Kers, L.E. 1989. Barrtryffel, *Hydnotrya michaelis*, i Sverige. Svensk Botanisk Tidskrift 83: 315-322.

Kimbrough, J.W. 1970. Current trends in the classification of discomycetes. The Botanical Review 36: 91-161.

Kimbrough, J.W. 1989. Arguments towards restricting the limits of the Pyronemataceae (Ascomycetes, Pezizales). Memoirs of the New York Botanical Garden 49: 326-335.

Kimbrough, J.W. 1991. Ultrastructural observations on Helvellaceae (Pezizales, Ascomycetes). V. Septal structures in *Gyromitra*. Mycological Research 95: 421-426.

Kimbrough, J.W. and J.L. Gibson. 1989. Ultrastructural observations on Helvellaceae (Pezizales, Ascomycetes). III. Septal structures in *Helvella*. Mycologia 81: 914-920.

Kimbrough, J.W. and J.L. Gibson. 1990. Ultrastructural and cytological observations of apothecial tissues of *Geopyxis carbonaria* (Pezizales, Ascomycetes). Canadian Journal of Botany 68: 243-257.

Kimbrough, J.W., L. Li, and C. Wu. 1996. Ultrastructural evidence for the placement of the truffle *Barssia* in the Helvellaceae (Pezizales). Mycologia 88: 38-46.

Kimbrough, J.W., C. Wu, and J.L. Gibson. 1990. Ultrastructural observations on Helvellaceae (Pezizales, ascomycetes). IV. Ascospore ontogeny in selected species of *Gyromitra* subgenus *Discina*. Canadian Journal of Botany 68: 317-328.

Korf, R.P. 1972. Synoptic key to the genera of the Pezizales. Mycologia 64: 937-994.

Korf, R.P. 1973a. Discomycetes and Tuberales. In: The Fungi. An advanced treatise (Ainsworth, Sparrow and Sussman eds.) IVA: 249-319. Academic Press, New York.

Korf, R.P. 1973b. Sparassoid ascocarps in Pezizales and Tuberales. Reports of the Tottori Mycological Institute (Japan) 10: 389-403.

Korf, R.P. 1988. Some forgotten Discomycete combinations. Mycotaxon 31: 379-382.

Korf, R.P. and W.Y. Zhuang. 1985. Some new species and new records of Discomycetes in China. Mycotaxon 22: 483-514.

Korf, R.P. and W.Y. Zhuang. 1991. A preliminary Discomycete flora of Macronesia: Part 13, Morchellaceae, Helvellaceae. Mycotaxon 40: 287-294.

Kotlaba, F. and Z. Pouzar. 1974. Additional localities of *Gyromitra fastigiata*. Ceská Mykologie 28: 84-95.

Krieglsteiner, G.J. 1981. Über einige neue, seltene, kritische Makromyceten in der Bundesrepublik Deutschland. III. (mit einer Farbtafel nach Deapositiv von M. Meusers). Beihefte zur Zeitschrift für Mykologie 48: 430-64.

Kristiansen, R. 1983. Contributions to the Ascomycete Flora of Østfold county, SE Norway. II. Agarica 4: 220-264.

Lange, M. 1956. Danish Hypogeous Macromycetes. Dansk Botanisk Arkiv 16: 7-84.

Larsen, H.J. Jr. and W.C. Denison. 1978. A checklist of the operculate cup-fungi (Pezizales) of North America west of the great plains. Mycotaxon 7: 68-90.

Linnaeus, C. 1753. Species Plantarum. Holmiae.

Liu, B., F. Du, and J.Z. Cao. 1985. New species and new combination of the genus *Helvella*. Acta Mycologica Sinica 4: 208-217.

Liu, B. and J.Z. Cao. 1988. Some new species and new records of the genus *Helvella* from China (I). Acta Mycologica Sinica 7: 198-204.

Maas Geesteranus, R.A. 1967. De fungi van Nederland 2a. Pezizales - deel I (Discinaceae, Helvellaceae, Morchellaceae, Pezizaceae, Rhizinaceae). Wetenschappenlijke Mededelingen van de Koninklijke Nederlandse Natuurhistorische Vereniging 69: 1-72.

Maia, L.C., A.M. Yano, and J.W. Kimbrough. 1996. Species of Ascomycota forming ectomycorrhizae. Mycotaxon 57: 371-390.

Martinez-amores, E., M. Valdes, and M. Quintos. 1991. Seedling growth and ectomycorrhizal colonization of *Pinus patula* and *P. radiata* with spores of *Helvella lacunosa, Russula brevipes* or *Lycoperdon perlatum*. New Forests 4: 237-245.

Massee, G. 1909. The structure and affinities of British Tuberaceae. Annals of Botany 23: 243-263 + plate.

McKnight, K.H. 1968. Artifacts on spores of Disciniae induced by common reagents. Mycologia 60: 723-727.

McKnight, K.H. 1969. A note on *Discina*. Mycologia 61: 614-630.

McKnight, K.H. 1971. On two species of false morels (*Gyromitra*) in Utah. The Great Basin Naturalist 31: 35-47.

McKnight, K.H. 1973. Two misunderstood species of *Gyromitra* (false morel) in North America. The Michigan Botanist 12: 147-162.

McKnight, K.H. and L.R. Batra. 1974. Scanning electron microscopy in taxonomy of gyromitroid fungi. The Michigan Botanist 13: 51-64.

Miller, S.L. and O.K. Miller. 1982. Hypogeous mycorrhizal fungi from the southeastern U.S.A. Virginia Journal of Science 33: 128.

Moravec, J. 1966. Jak dlouho mohou vytrvávat plodnice ucháche obecného *Gyromitra esculenta* (Pers. ex Fr.) Fr. v prírode. Mykologicky Sbornik 43: 27.

Moravec, J. 1980. *Helvella leucopus* Pers. in Czechoslovakia. (Discomycetes, Helvellaceae). Ceská Mykologie 34: 214-216.

Moravec, J. 1986. A revision of the type of *Gyromitra bubacii* and the problem of ascospore size in *Gyromitra esculenta* (Discomycetes). Ceská Mykologie 40: 11-18.

Morgan, P. and C.H. Driver. 1973. *Rhizina* root rot in conifer plantations in western Washington. Plant Disease Reporter 57: 167-169.

Morgan, P., E.K. Wallin, and C.H Driver. 1974. Occurrence of *Rhizina* root rot in an old-growth conifer stand in the pacific northwest. Plant Disease Reporter 58: 492-494.

Morse, E.E. 1945. Some western discomycetes - *Gyromitra esculenta*, *Helvella lacunosa*. Mycologia 37: 414-424.

Nannfeldt, J.A. 1937. Contributions to the mycoflora of Sweden. Svensk Botanisk Tidskrift 31: 47-66 + plates.

Nemlich, H. and Z. Avizohar-Hershenzon. 1972. Pezizales of Israel. I. Morchellaceae and Helvellaceae. Israel Journal of Botany 21: 153-163.

Östergren, G. and W. Heneen. 1962. A squash technique for chromosome morphological studies. Hereditas 48: 332-341.

Patouillard, N. 1925. Sur le *Geopora michaelis* Fisch. Bulletin de la Societé Mycologique de France 41: 343-344.

Pegler, D.N., B.N. Spooner and T.W.K. Young. 1993. British Truffles. A revision of British Hypogeous Fungi. Royal Botanic Gardens, Kew.

Persoon, C.H. 1796-1799. Observationes mycologicae seu descriptiones tam novorum tam notabilium fungorum 1: 1-115, 2: 1-106 + plates. Lipsia.

Persoon, C.H. 1800. Commentarius D. Jac. Christ. Schaefferi, Fungorum Bavariae indigenorum icones pictas, illustrans p. 1-130.

Petersen, P.M. 1985. The ecology of Danish soil inhabiting Pezizales with emphasis on edaphic conditions. Opera Botanica 77: 1-38.

Pfister, D.H. 1977. Type studies in the genus *Peziza*: species described by Berkeley and Curtis from the United States north Pacific exploring expedition (1853-1856). Mycotaxon 6: 337-340.

Pfister, D.H. 1980. On "*Peziza*" *melaleucoides*--a species of *Gyromitra* from the western United States. Mycologia 72: 614-619.

Pomerleau, R. 1980. Flore des champignons au Québec. Les editions la presse, Lteé, Ottawa.

Pouzar, Z. 1961. Systematická hodnota uchácovce sumavského -- *Helvellella gabretae* (Kavina) Pouz. et Svr. Ceská Mykologie 15: 42-45.

Quélet, L. 1873. Les champignons du Jura et des Vosges 2: 321-424 + plates.

Rahm, E. 1970. Über einige Rhizinaceae aus dem Hochtal von Arosa. Schweizerische Zeitschrift für Pilzkunde 48: 77-87+plate

Raitviir, A. 1965. Taxonomical notes on the genus *Gyromitra*. Eesti NSV Teaduste Akadeemia Toimetised. 14 (Bioloogiline Seeria 3): 320-324.

Raitviir, A. 1970. Once more on *Neogyromitra caroliniana*. Tartu riikliku ülikooli toimetise. Botanika alased tõõd. 9: 364-373.

Raudaskoski, M., K. Pohjola. and I. Saarvanto. 1976. Effect of temperature and light on the mycelial growth of *Gyromitra esculenta* in pure culture. Karstenia 16: 1-5.

Rea, C. 1928. New or rare British Discomycetae. Transactions of the British Mycological Society 13: 253-260.

Rehm, H. 1904. Ascomycetes Americae borealis. Annales Mycologici 2: 351-354.

Rifai, M.A. 1968. The Australasian Pezizales in the herbarium of the Royal Botanic Gardens Kew. Verhandlingen Koninklijke Nederlandse Akademie van Wetenschappen, Afd. Natuurkunde 57: 1-295.

Roponen, I. and M. Kreula. 1978. On the mycelial growth of the lorel or false morel. Karstenia: 18: 58-63.

Ryman, S. 1979. Svenska vår - och försommarsvampar inom Pezizales. Svensk Botanisk Tidskrift 72: 327-339.

Samuelson, D.A. 1978. Asci of the Pezizales. VI. The apical apparatus of *Morchella esculenta*, *Helvella crispa*, and *Rhizina undulata*. General discussion. Canadian Journal of Botany 56: 3069-3082.

Samuelson, D.A., G.L. Benny, and J.W. Kimbrough. 1987. Ultrastructure of ascospore ornamentation in *Elaphomyces* (Ascomycetes). Mycologia 79: 571-577.

Satô, K., Y. Yokozawa and T. Shôji. 1974. Studies on *Rhizina* root rot causing group dying of pine trees. Bulletin. Government Forest Exp. Station 268: 13-48 + plates.

Schaeffer, J.C. 1762-1774. Fungorum qui in Bavaria et Palatinatu circa Ratisbonam nascuntur icones nativis coloribus expressae 1-4. Ratisbonam.

Schalkwyk, H. 1977. Leni Schalkwyk's checklist of fungi of Alberta. The Stinkhorn (Edmonton Mycological Club) 3: 1-66.

Schumacher, T. 1992. New or noteworthy discomycetes. 2. Five new operculate discomycetes (Pezizales) from the Dovre Mountains, central south Norway. Mycotaxon 63: 33-47.

Schumacher, T. and K. Mohn Jenssen. 1992. Arctic and alpine fungi - 4. Soppkonsulenten A/S, Oslo.

Scopoli, J.A. 1772. Flora carniolica Editio secunda. 1: 1-488, 2: 1-496.

Seaver, F.J. 1921. Photographs and descriptions of cup-fungi--IX. North American species of *Discina*. Mycologia 13: 67-71.

Seaver, F.J. 1928. The North American cup-fungi (operculates). Seaver (pub.), New York.

Seaver, F.J. 1942. The North American cup-fungi (operculates). Supplement. Seaver (pub.), New York.

Smits'ka, M.F. 1981. Ecological groups of operculate Discomycetes. Ukrainski Botanichnii Zhurnal 38: 83-84.

Smits'ka, M.F. 1981. Probable evolution relations between operculate Discomycetes' genera. Mikologiya; Fitopatologiya 15: 55-59.

Smits'ka, M.F. and N.N. Slavnaya. 1978. Systematic position of *Helvella* and *Morchella* fungi and their investigation in the Soviet Union. Mikologiya; Fitopatologiya 12: 284-288.

Snyder, L.C. 1936. New and unusual Discomycetes of western Washington. Mycologia 28: 483-488.

Soehner, E. 1951. Tuberaceen-studien III. Zeitschrift für Pilzkunde 8: 7-16.

Spooner, B.M. 1992. A new species of *Hydnotrya* (Helvellaceae) from the British Isles. Kew Bulletin 47: 502.

Svrcek, M. and J. Moravec. 1972. O druhu *Helvella fastigiata* Krombholz. Ceská Mykologie 26: 1-8.

Teudorowiczc F. von. 1928. Über massenhaftes Vorkommen der *Geopora michaelis* (Fisch.), Löchertrüffel in Polen. Zeitschrift für Pilzkunde 7: 79-80.

Tewari, V.P., N.N. Raghavendra Rao, and D.C. Pant. 1971. Ascomycetes of India - VIII. New records of *Helvella* species. Norwegian Journal of Botany 18: 183-185.

Thies, W.G., K.W. Russell, and L.C. Weir. 1977. Distribution and damage appraisal of *Rhizina undulata* in western Oregon and Washington. Plant Disease Reporter 61: 859-862.

Torkelsen, A.E. 1985. *Pseudorhizina sphaerospora* - a rare, beautiful fungus of early summer. Agarica 6: 358-362.

Torre, M. de la. 1976. Contribution to the study of the genus *Gyromitra* in Spain. Boletin de la Estacion Central de Ecologia. 10: 33-38.

Trappe, J.M. 1971. Mycorrhiza-forming Ascomycetes. In: Mycorrhizae, Proceedings of the first North American Conference on Mycorrhizae, April 1969 (E. Hacskaylo ed.). Miscl. publication 1189, United States Department of Agriculture - Forest Service, p. 19-37.

Trappe, J.M. 1975a. Generic synonyms in the Tuberales. Mycotaxon 2: 109-122.

Trappe, J.M. 1975b. The genus *Fischerula* (Tuberales). Mycologia 67: 934-941.

Trappe, J.M. 1976. Notes on Japanese hypogeous Ascomycetes. Transactions of the Mycological Society of Japan 17: 209-217.

Trappe, J.M. 1979. The orders, families, and genera of hypogeous Ascomycotina (Truffles and their relatives). Mycotaxon 9: 297-340.

Trappe, J.M. 1989. *Cazia flexiascus* gen. et sp. nov., a hypogeous fungus in the Helvellaceae. Memoirs of the New York Botanical Garden 49: 336-338.

Trappe, J.M., M.A. Castellano, and N. Malajczuk. 1992. Australasian truffle-like fungi II. *Labyrinthomyces, Dingleya* and *Reddellomyces* gen. nov. (Ascomycotina). Australian Systematic Botany 5: 597-611.

Vries, G.A. de. 1981. Een nieuwe vindplaats in Nederland van de olieboltruffel, *Hydnotrya michaelis.* Coolia 24: 33-34.

Waraitch, K.S. 1976. Some *Helvellas* new to India. Proceedings of the Indian Academy of Science 84: 210-214.

Weber, N.S. 1972. The genus *Helvella* in Michigan. The Michigan Botanist 11: 147-201.

Weber, N.S. 1975. Notes on western species of *Helvella*. I. Beihefte Nova Hedwigia 51: 25-38.

Weber, N.S. 1988. A morel hunter's companion. A guide to the true and false morels of Michigan. Michigan Natural Resources Magazine, TwoPeninsula Press, Lansing, Michigan.

Zeller, S.M. 1927. Contributions to our knowledge of Oregon fungi. II. Mycologia 19: 130-143.

Zhang, B.C. 1991. Morphology, cytology and taxonomy of *Hydnotrya cerebriformis* (Pezizales). Mycotaxon 42: 155-162.

Zhang, B.C. and D.W. Minter. 1989a. Morphology, cytology and taxonomy of *Choiromyces gangliiformis* (Ascomycotina, Pezizales). Mycological Research 92: 91-94.

Zhang, B.C. and D.W. Minter. 1989b. *Gymnohydnotrya*: a new hypogeous ascomycete genus from Australia. Mycological Research 92: 192-198.

Zhuang, W.Y. 1995. Some new species and new records of discomycetes in China. V. Mycotaxon 56: 31-40.

Figure Legends

Figures 1-2: Ascocarps of *Gyromitra*. **Fig. 1**: *Gyromitra* subgen. *Gyromitra*. **Fig. 1a:** *Gyromitra ambigua*, SA 198, in situ, bar = 10 mm. **Fig. 1b:** *Gyromitra infula*, SA 277, in situ, bar = 15 mm. **Fig. 2**: *Gyromitra* subgen. *Discina*. **Fig. 2a:** *Gyromitra gigas*, ALTA 8443, in situ, bar = 20 mm. **Fig. 2b:** *Gyromitra olympiana*, SA 331, in situ beside melting snowbank (right), bar = 10 mm. **Fig. 2c:** *Gyromitra perlata*, SA 27, young ascocarps in situ, bar = 10 mm.

Figures 3-4: Ascocarps of *Helvella*. **Fig. 3:** *Helvella* subgen. *Leucomelaenae*. **Fig. 3a**: *Helvella leucomelaena*, SA 56, ascocarps in situ and showing sparingly ribbed stipe, bar = 10 mm. **Fig. 3b:** *Helvella solitaria,* UAMH M565, in situ, bar = 10 mm. **Fig. 3c:** *Helvella unicolor,* SA 131, in situ and showing excipular surface, bar = 10 mm. **Fig. 3d:** *Helvella unicolor,* SA 135, showing prominently ribbed stipe, bar = 15 mm. **Fig. 3e:** *Helvella costifera,* SA 100, showing prominently ribbed stipe and excipulum, bar = 10 mm. **Fig. 4:** *Helvella* subgen. *Silvicolae*. **Fig. 4a**: *Helvella silvicola*, SA 371, atypical auriculoid-cupulate ascocarp showing excipulum and ribbed stipe, bar = 10 mm. **Fig. 4b:** *Helvella silvicola,* ALTA 8284, typical auriculoid ascocarps in situ, bar = 15 mm. **Fig. 4c:** *Helvella silvicola,* SA 379, note auriculoid apothecia and ribbed stipe (right), bar = 10 mm.

Figures 5-8: Ascocarps of *Helvella.* **Fig. 5:** *Helvella* subgen. *Elasticae.* **Fig. 5a:** *Helvella atra*, SA 110, in situ, bar = 10 mm. **Fig. 5b:** *Helvella elastica*, SA 221, in situ, bar = 10 mm. **Fig. 5c:** *Helvella latispora,* SA 374, bar = 10 mm. **Figs. 6-8:** *Helvella* subgen. *Helvella.* **Fig. 6**: *Helvella crispa.* **Fig. 6a:** ALTA 8319, young (left) and mature (right) ascocarps, bar = 10 mm. **Fig. 6b:** SA 256, in situ, bar = 15 mm. **Fig. 7**: *Helvella maculata,* SA 380, young ascocarps showing excipular surface (left) and margin strongly inrolled over hymenium (right), bar = 10 mm. **Fig. 8**: *Helvella lacunosa*, SA 111, in situ, bar = 10 mm.

Figures 9-12: Dried ascocarps of *Helvella* and *Underwoodia*. **Fig. 9**: *Helvella macropus*, UBC F3217, bar = 10 mm. **Fig. 10:** *Helvella rivularis*, C (part of holotype), bar = 10 mm. **Fig. 11**: *Helvella verruculosa*. **Fig. 11a:** DAOM 20767, note white marginal pubescence, bar = 5 mm. **Fig. 11b:** DAOM 20767, showing ribbing on stipe and excipulum, bar = 5 mm. **Fig. 12**: *Underwoodia columnaris,* DAOM 206825, ascocarps including longitudinal and cross (above) sections, bar = 10 mm.

Figures 13-17: Ascocarps of *Pseudorhizina* and *Hydnotrya*. **Fig. 13**: *Pseudorhizina californica*, DAOM 107197, dried ascocarp, bar = 15 mm. **Fig. 14**: *Pseudorhizina sphaerospora*. **Fig. 14a:** SA 38, in situ, bar = 10 mm. **Fig. 14b:** SA 350, showing prominently ribbed stipe and reflexed apothecium, bar = 10 mm. **Fig. 15**: *Hydnotrya michaelis,* DAOM 14081 (holotype of *H. yukonensis*), dried ascocarp, bar = 5 mm. **Fig. 16**: *Hydnotrya cubispora*, WTU (Stz 13359), dried ascocarp in longitudinal section, bar = 5 mm. **Fig. 17**: *Hydnotrya variiformis*, WSP 39119, dried ascocarp, bar = 5 mm.

Figures 18-28: Microscopic features of apothecia of Helvellaceae. **Fig. 18**: *Helvella macropus*, WK 6368, fascicled hyphae of ectal excipulum outer surface, bar = 25 µm. **Fig. 19**: *Gyromtira esculenta*, SA 20, apothecium cross section, hymenium and medullary excipulum, bar = 50 µm. **Fig. 20**: *Helvella leucomelaena*, SA 322, apothecium cross section, hymenium (h), subhymenium (s), medullary excipulum (m), and ectal excipulum (e), bar = 75 µm. **Fig. 21**: *Gyromitra ambigua*, SA 191, fascicled/branched, septate paraphyses, bar = 20 µm. **Fig. 22**: *Rhizina undulata*, WK 5983, thick-walled, aseptate seta, bar = 15 µm. **Fig. 23**: *Helvella aestivalis*, C EI84.48, pleurorhynchous ascus base, bar = 15 µm. **Fig. 24**: *Helvella oblongispora,* C (holotype), aporhynchous ascus base, bar = 15 µm. **Fig. 25**: *Helvella robusta*, ALTA 8291 (paratype), apex of ascus after spore release, including operculum, bar = 10 µm. **Fig. 26**: Ascospores with de Bary bubbles. **Fig. 26a:** *Rhizina undulata*, WK 5983, bar = 20 µm. **Fig. 26b:** *Pseudorhizina sphaerospora*, SA 350, bar = 10 µm. **Fig. 27**: *Helvella silvicola*, SA 379, SEM of hymenium cross section, asci with uniseriate ascospores and clavate paraphyses, bar = 20 µm. **Fig. 28**: *Hydnotrya cerebriformis*, WK 3023, apex of ascus including ascospores and operculum (arrow), bar = 20 µm.

Figures 29-34: SEM ascospores of *Gyromitra* subgenus *Gyromitra* and subgenus *Discina*. **Fig. 29**: *Gyromitra ambigua*, DAOM 195475, bar = 4 µm. **Fig. 30**: *Gyromitra esculenta*, SA 358, ascospore apex, bar = 1 µm. **Fig. 31**: *Gyromitra perlata*, WSP 56311, bar = 4 µm. **Fig. 32**:, *Gyromitra olympiana*, SA 325, ascospore apex, bar = 1 µm. **Fig. 33**: *Gyromitra perlata,* SA 337, bar = 5 µm. **Fig. 34**: *Gyromitra leucoxantha*, K. (herb. Bresadola), bar = 10 µm.

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Figures 41-46: SEM ascospores of *Pseudorhizina*, *Rhizina*, *Underwoodia*, *Helvella* subgenus *Helvella*, and *Helvella* subgenus *Elasticae*. **Fig. 41:** *Pseudorhizina sphaerospora*, SA 38, bar = 1 µm. **Fig. 42**: *Underwoodia columnaris*, DAOM 206824, bar = 4 µm. **Fig. 43**: *Rhizina undulata*, WTU ((Stz 16329), bar = 10 µm. **Fig. 44**: *Rhizina undulata*, WTU (Stz 16329), ascospore apex, bar = 1 µm. **Fig. 45**: *Helvella crispa*, SA 257, bar = 4 µm. **Fig. 46**: *Helvella atra*, SA 110, bar = 2 µm.

Figures 47-52: SEM ascospores *Helvella* subgenus *Cupuliformae,* subgenus *Elasticae,* subgenus *Leucomelaenae,* and subgenus *Silvicolae*. **Fig. 47**: *Helvella corium*, K (isotype of *H. arctica*), bar = 4 µm. **Fig. 48**: *Helvella chinensis*, WTU (Stz 11771), bar = 4 µm. **Fig. 49**: *Helvella compressa*, WTU (SDLB 03 25 1977), bar = 4 µm. **Fig. 50**: *Helvella leucomelaena*, WSP 54318, bar = 4 µm. **Fig. 51**: *Helvella silvicola*, ALTA 8273, bar = 4 µm. **Fig. 52**: *Helvella crassitunicata*, MICH (holotype), bar = 4 µm.

Figures 53-58: SEM ascospores *Helvella* subgenus *Macropodes* and subgenus *Cupuliformae*. **Fig. 53**: *Helvella macropus*, SA 120, bar = 4 µm. **Fig. 54**: *Helvella macropus*, ALTA 8294, bar = 4 µm. **Fig. 55**: *Helvella macropus*, SA 120, bar = 4 µm. **Fig. 56**: *Helvella macropus*, K (*Paxina subclavipes*, Ellis North American Fungi 985), bar = 4 µm. **Fig. 57**: *Helvella macropus*, DAOM 24706, bar = 4 µm. **Fig. 58**: *Helvella cupuliformis*, K (paratype), bar = 4 µm.

Figures 59-64: SEM ascospores *Hydnotrya* subgenus *Hydnotrya* and subgenus *Cerebriformae*. **Fig. 59**: *Hydnotrya cubispora*, WTU (SDLB 1523), bar = 10 µm. **Fig. 60**: *Hydnotrya cubispora*, WTU (SDLB 1523), bar = 8 µm. **Fig. 61**: *Hydnotrya tulasnei*, K (Lange 3082), bar = 10 µm. **Fig. 62**: *Hydnotrya variiformis*, K (Fogel 1174), bar = 10 µm. **Fig. 63**: *Hydnotrya cerebriformis*, K (Smith 08 18 1962), bar = 10 µm. **Fig. 64**: *Hydnotrya cerebriformis*, K (Smith 08 18 1962), bar = 10 µm.

Maps

Map 1: *Gyromitra esculenta*
Map 2: *Gyromitra infula*
Map 3: *Gyromitra ambigua, Gyromitra olympiana*
Map 4: *Gyromitra perlata*
Map 5: *Gyromitra gigas, Gyromitra leucoxantha*
Map 6: *Gyromitra melaleucoides*
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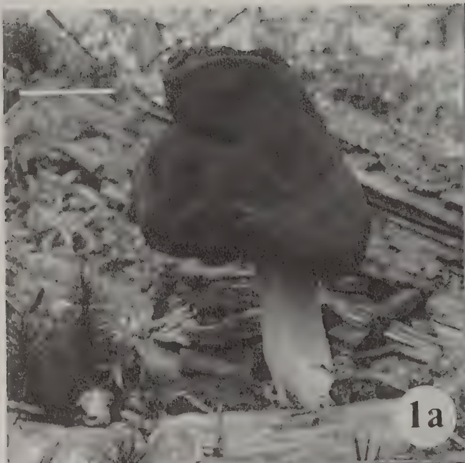
Map 9: *Helvella crispa, Helvella lactea*
Map 10: *Helvella maculata*
Map 11: *Helvella lacunosa*
Map 12: *Helvella leucomelaena, Helvella unicolor*
Map 13: *Helvella acetabulum, Helvella verruculosa, Helvella hyperborea*
Map 14: *Helvella costifera, Helvella aestivalis, Helvella robusta*
Map 15: *Helvella solitaria*
Map 16: *Helvella silvicola, Helvella crassitunicata*
Map 17: *Helvella corium, Helvella cupuliformis*
Map 18: *Helvella chinensis, Helvella rivularis*
Map 19: *Helvella macropus*
Map 20: *Helvella elastica*
Map 21: *Helvella albella*
Map 22: *Helvella compressa, Helvella ephippium, Helvella latispora*
Map 23: *Helvella pezizoides, Helvella atra, Underwoodia columnaris*
Map 24: *Hydnotrya cubispora, Hydnotrya variiformis, Hydnotrya tulasnei*
Map 25: *Hydnotrya cerebriformis, Hydnotrya michaelis*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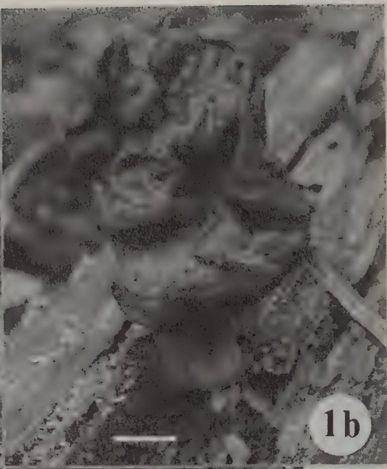
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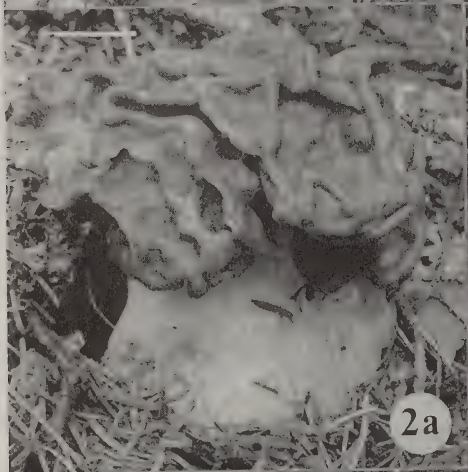
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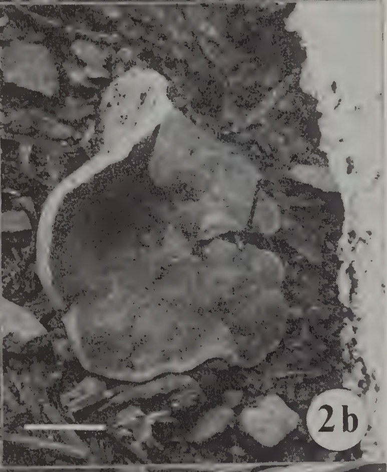
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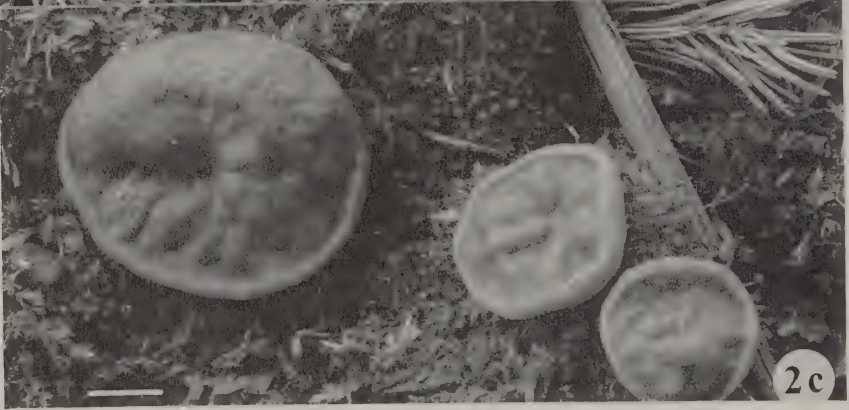
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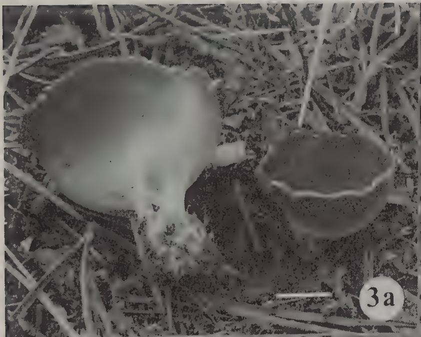
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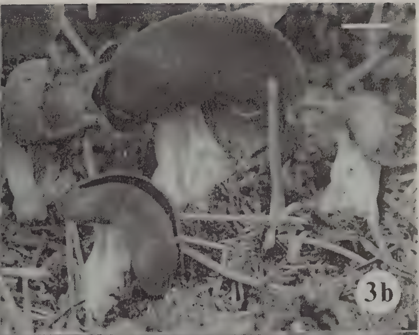
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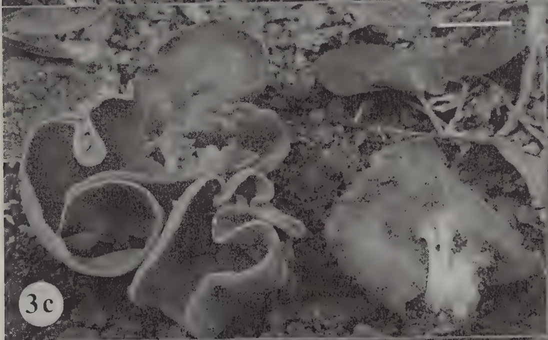
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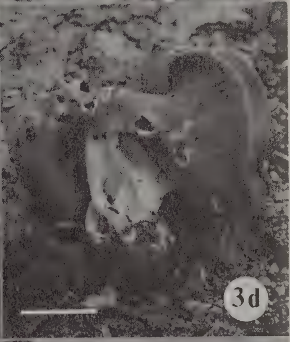
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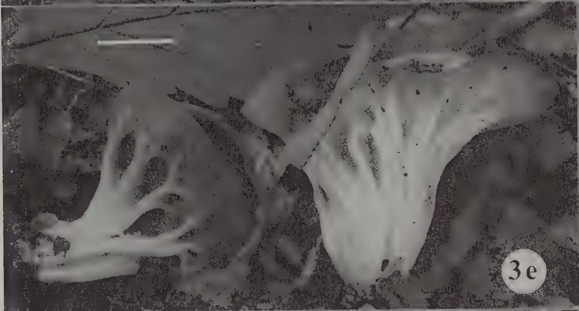
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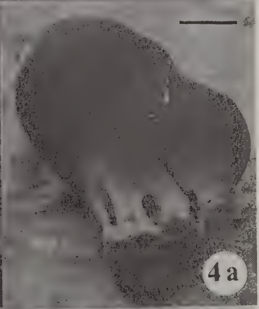
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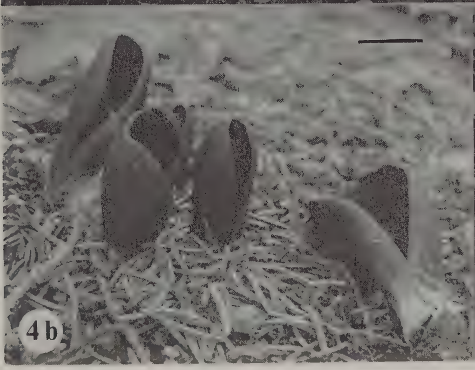
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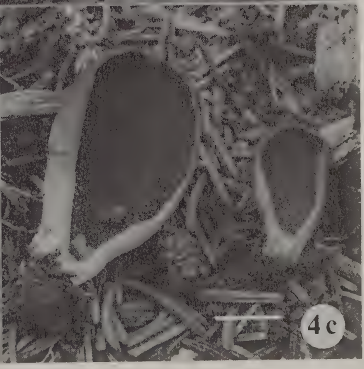
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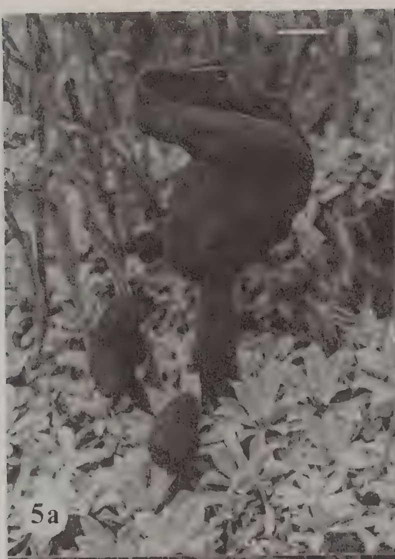

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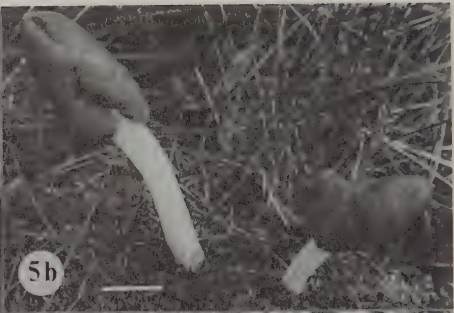

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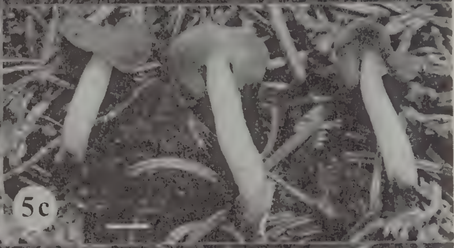

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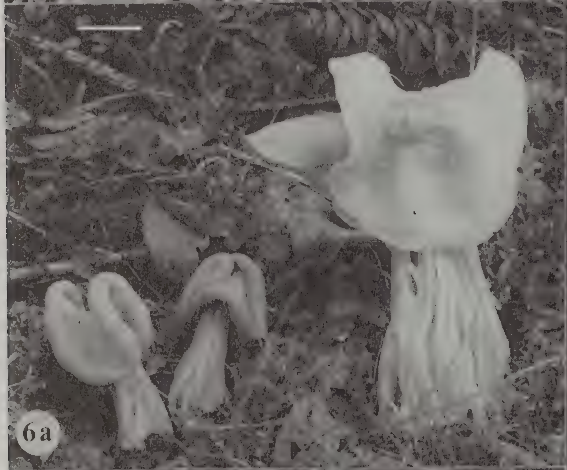

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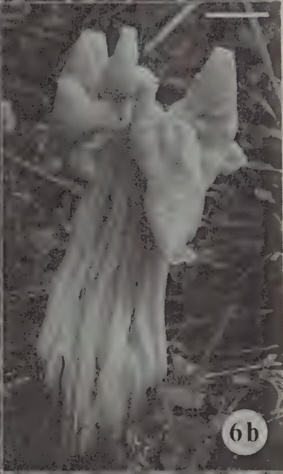

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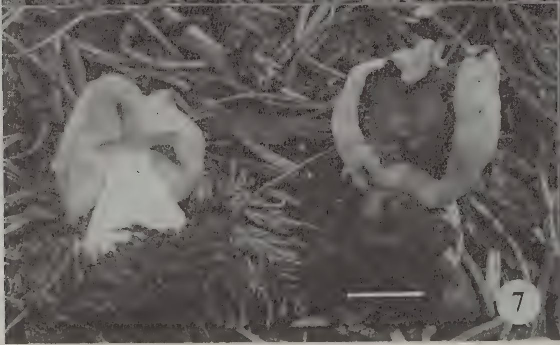

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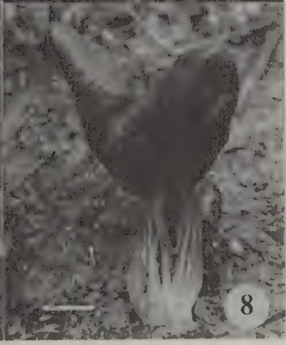

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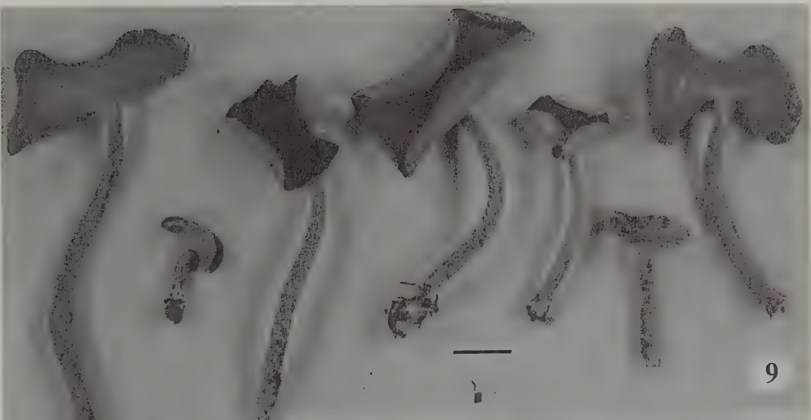
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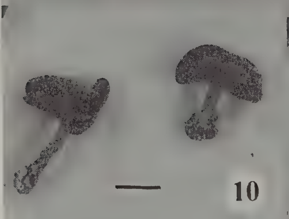
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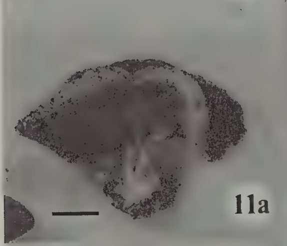
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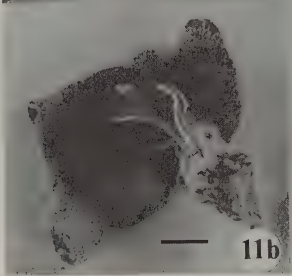
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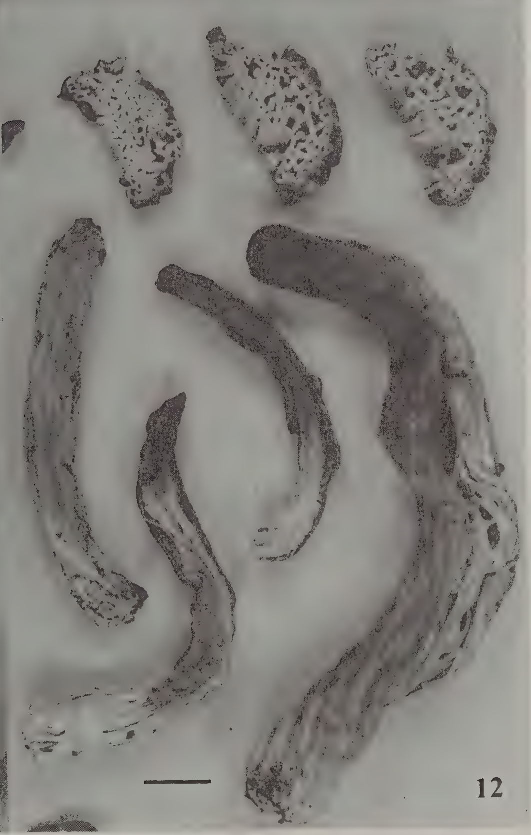
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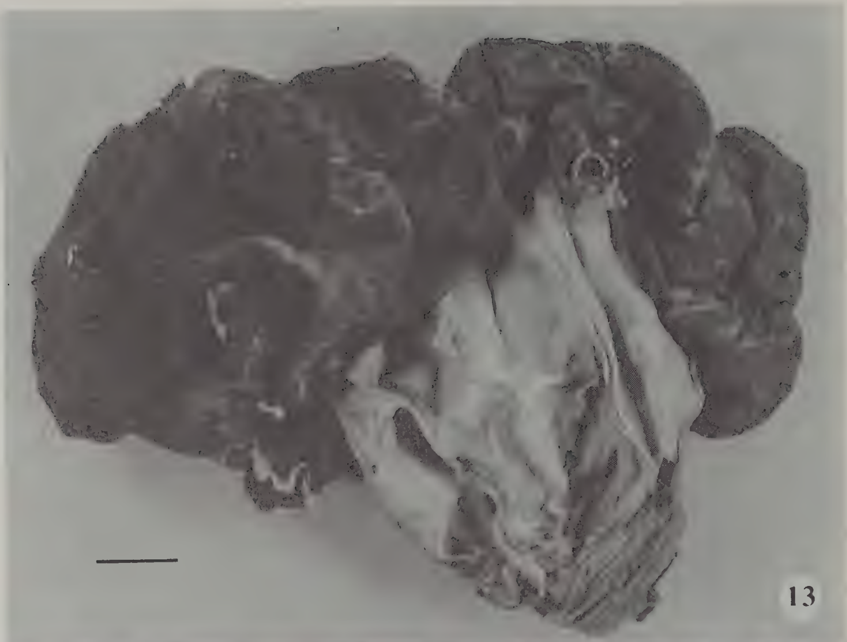
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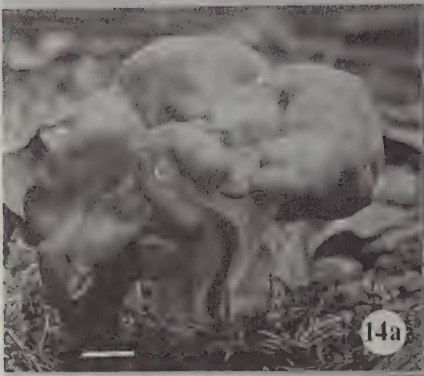
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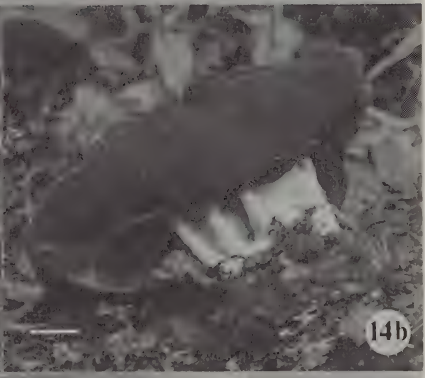
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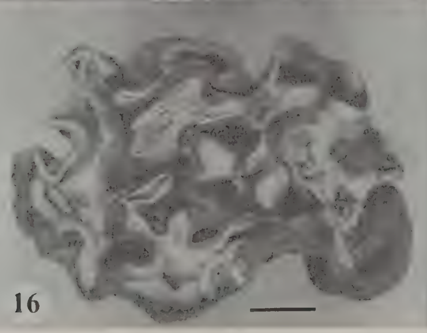
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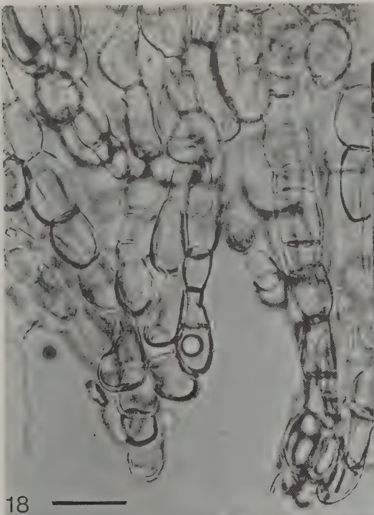
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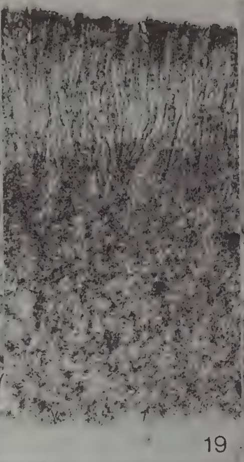
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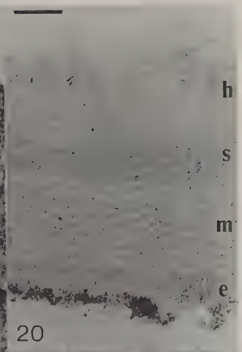
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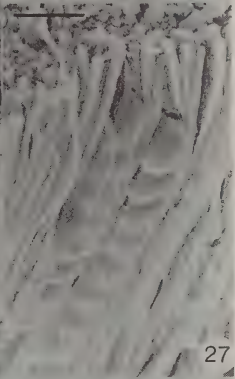
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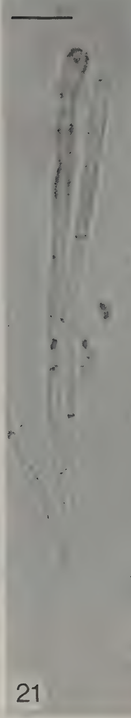
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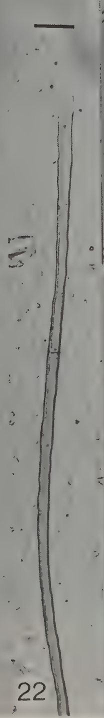
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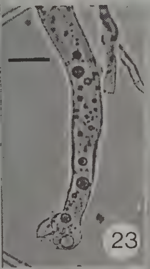
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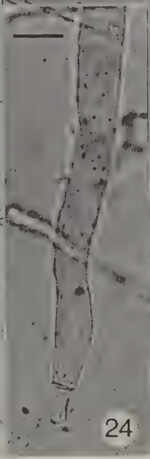
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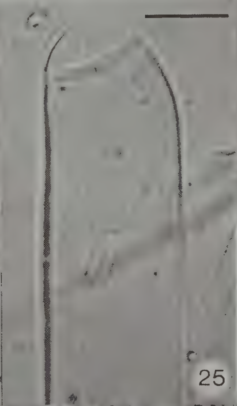
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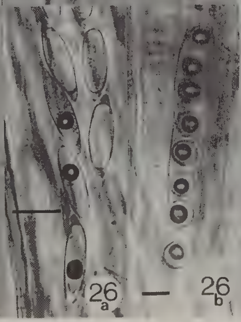
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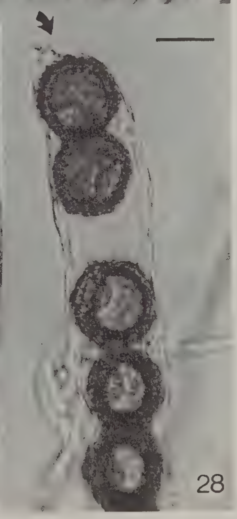
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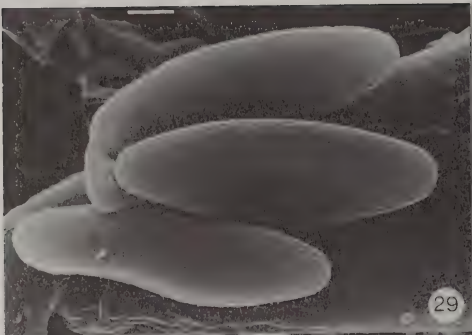
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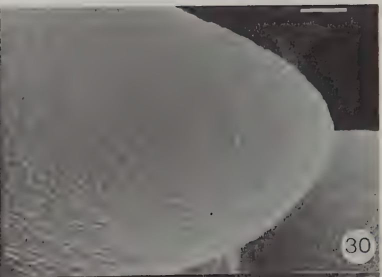
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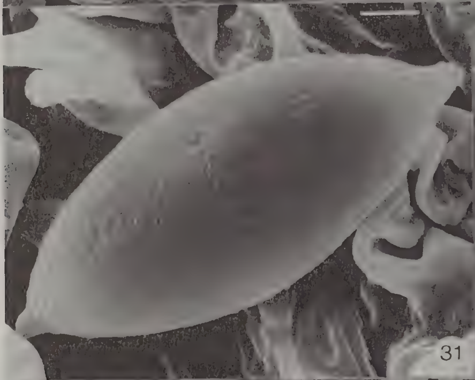
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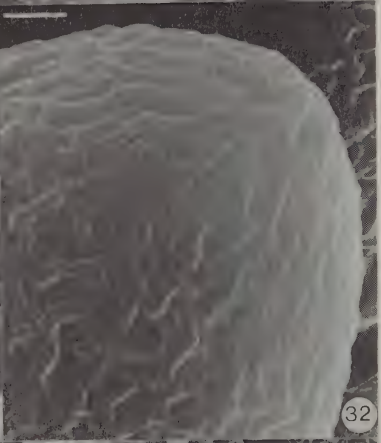
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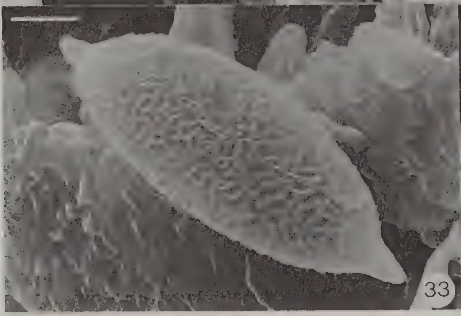
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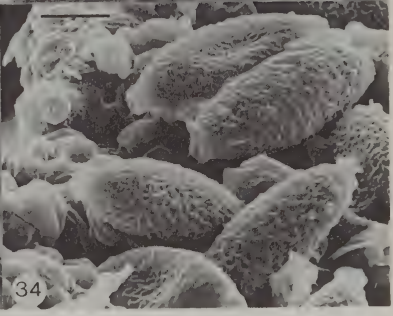
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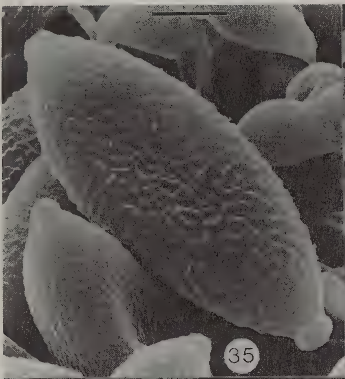
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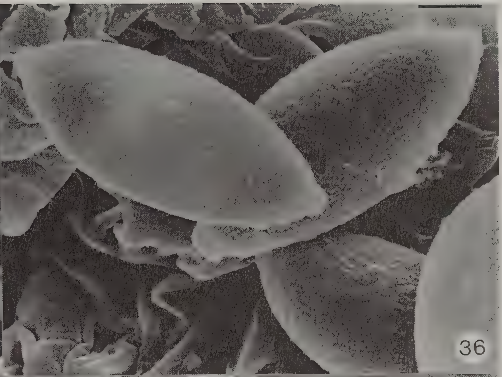
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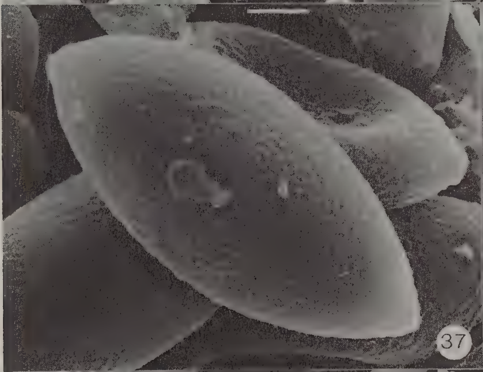
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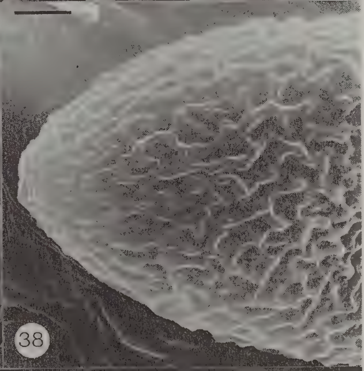
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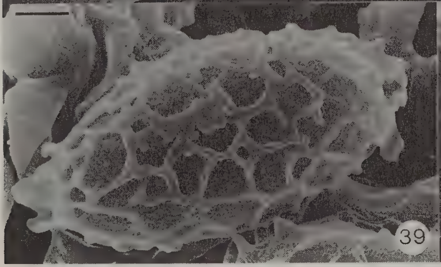
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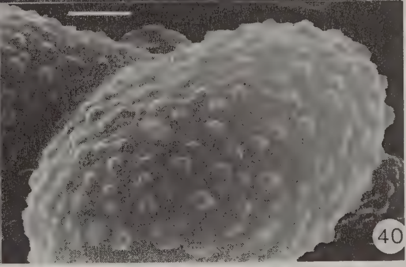
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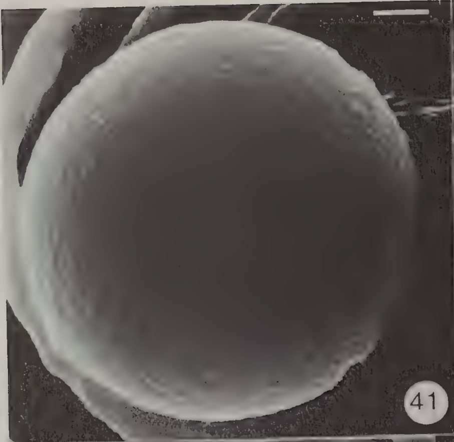
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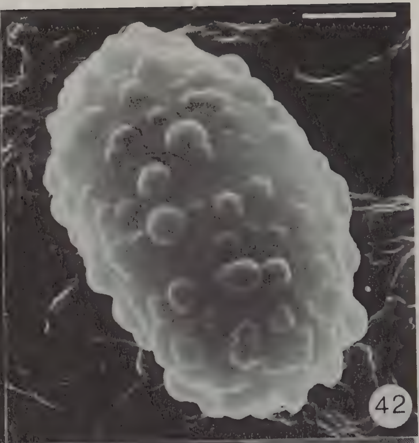
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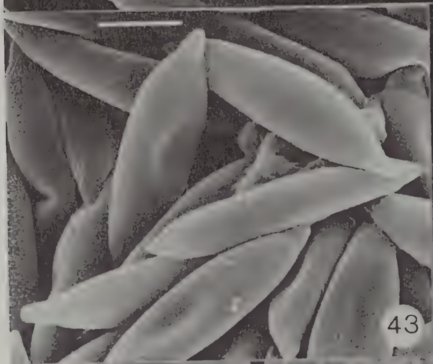
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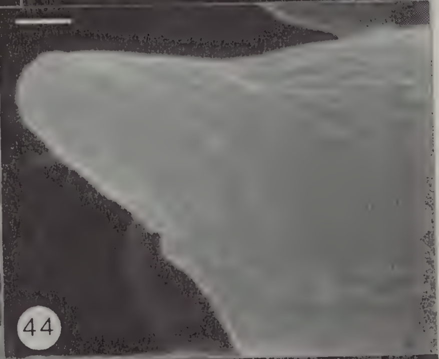
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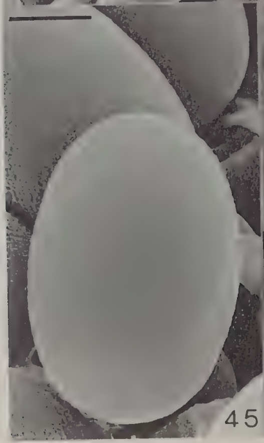
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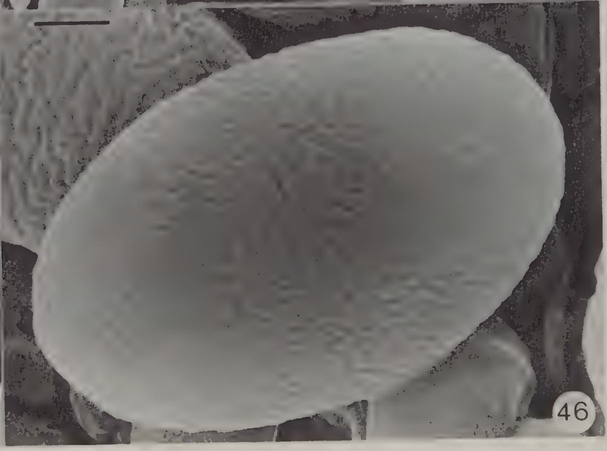
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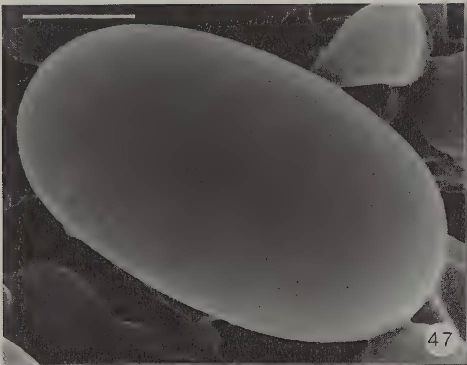

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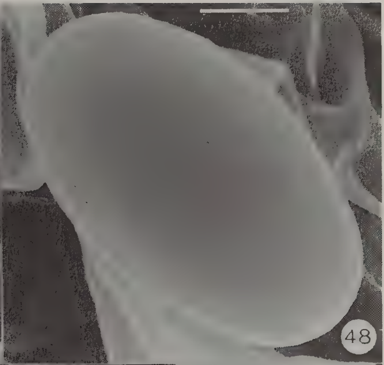

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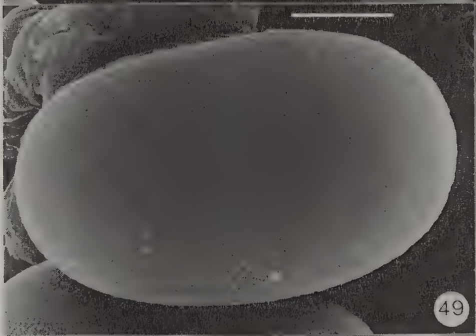

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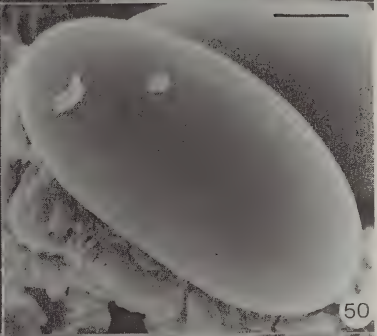

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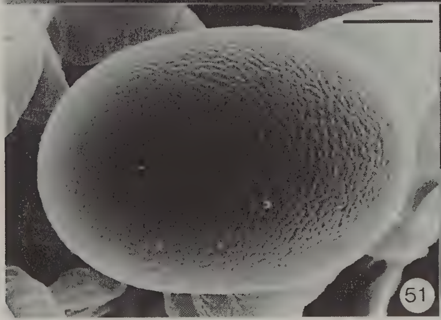

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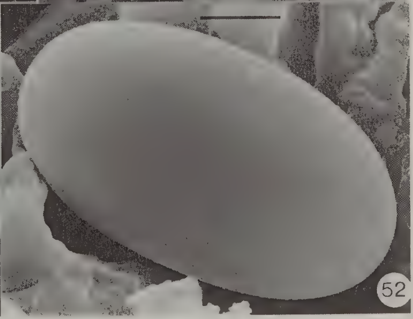

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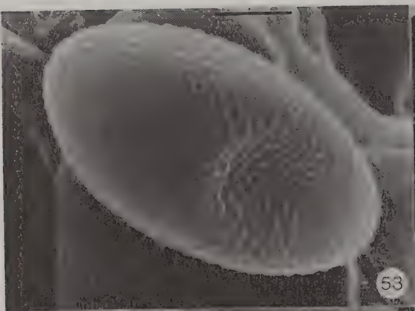
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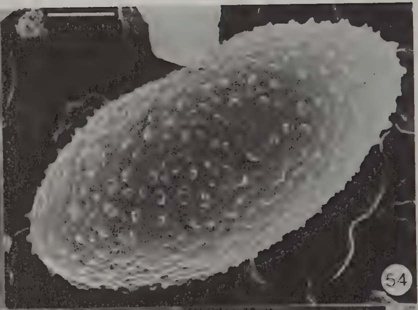
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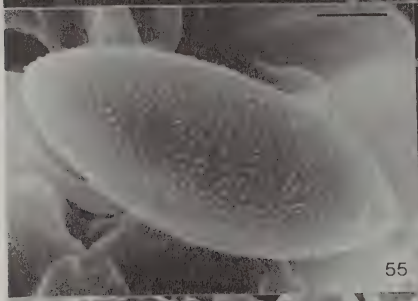
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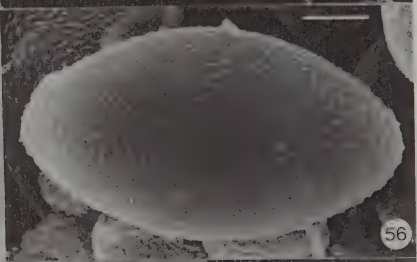
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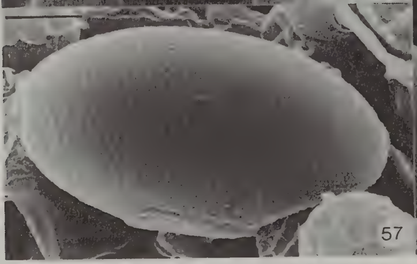
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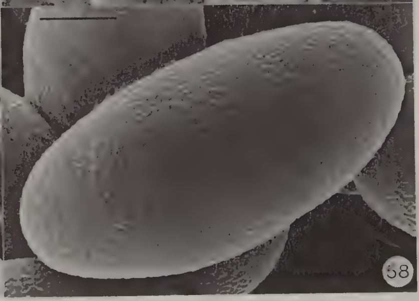
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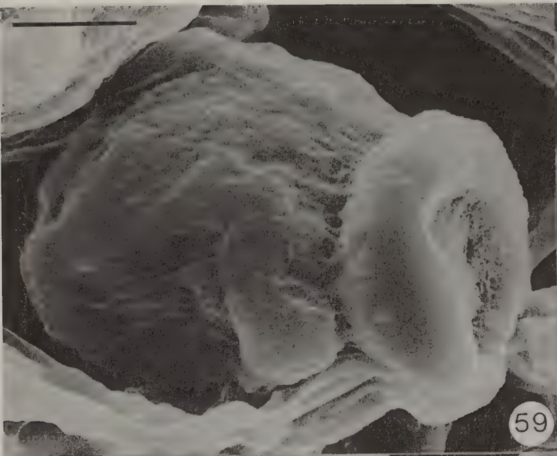

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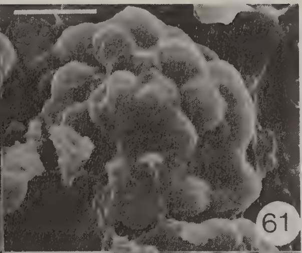

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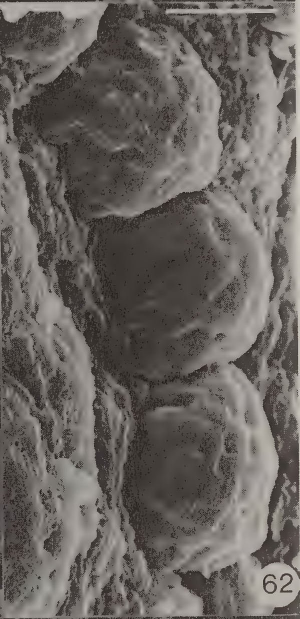

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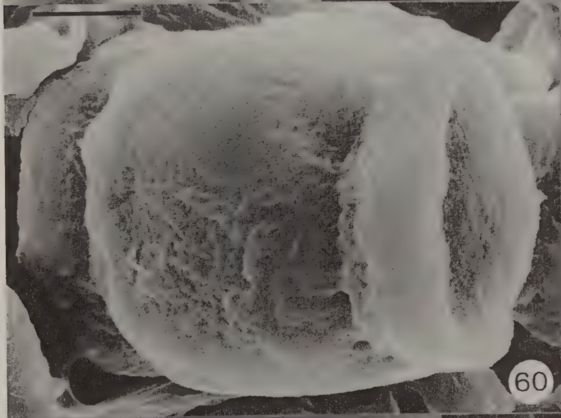

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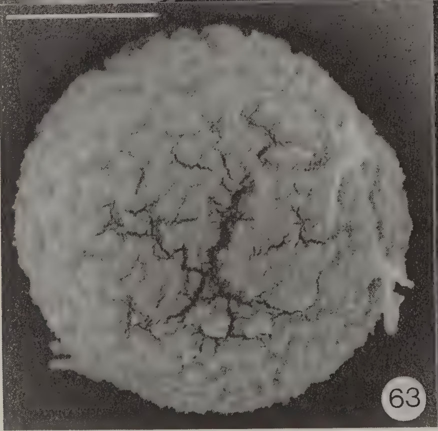

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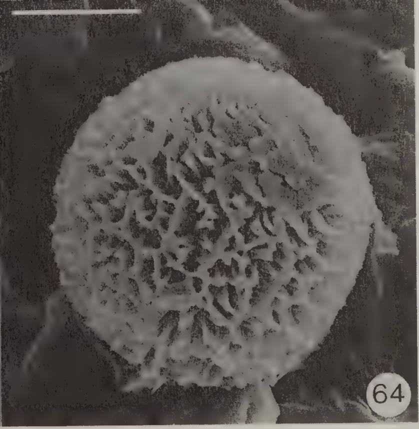

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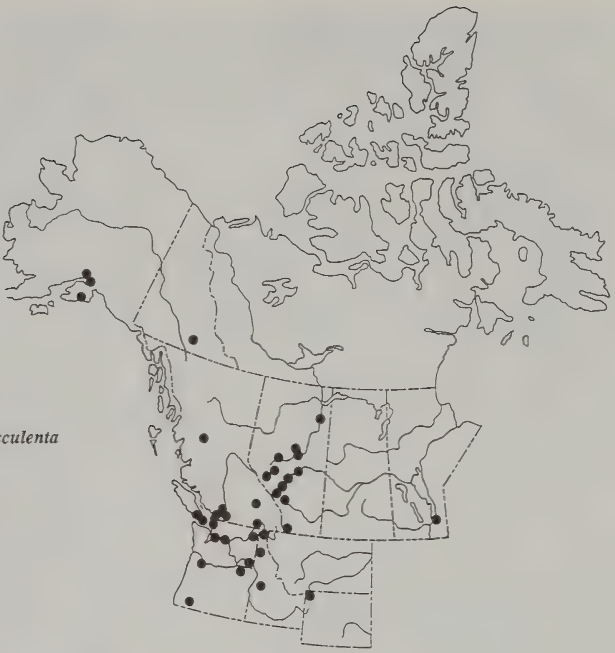
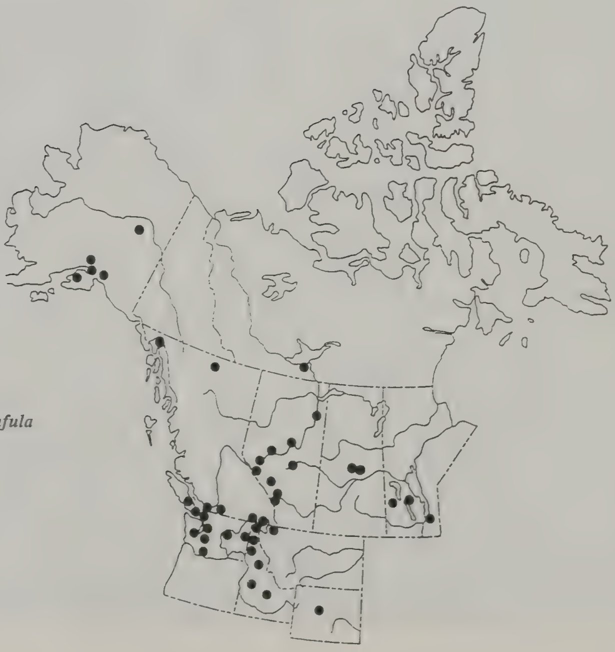


Map 1:

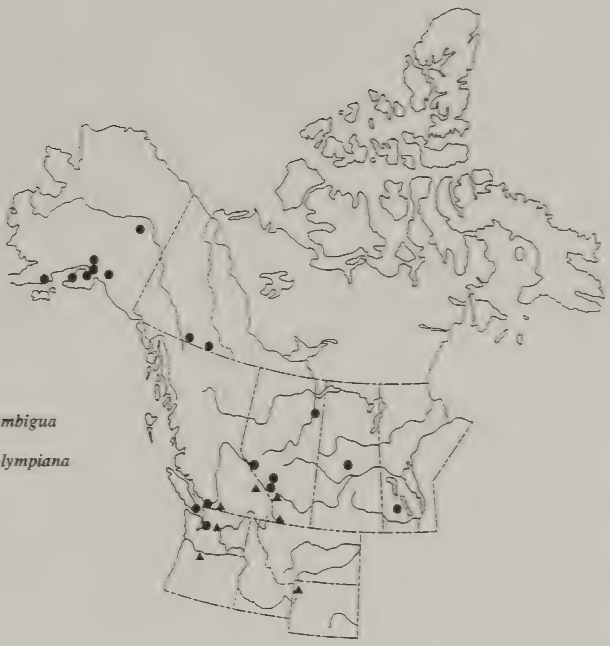
● *Gyromitra esculenta*



Map 2:

● *Gyromitra infula*

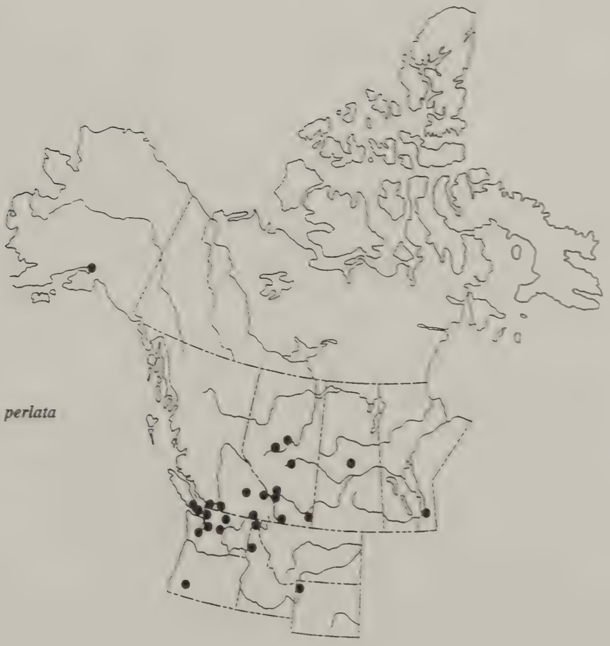
Map 3:



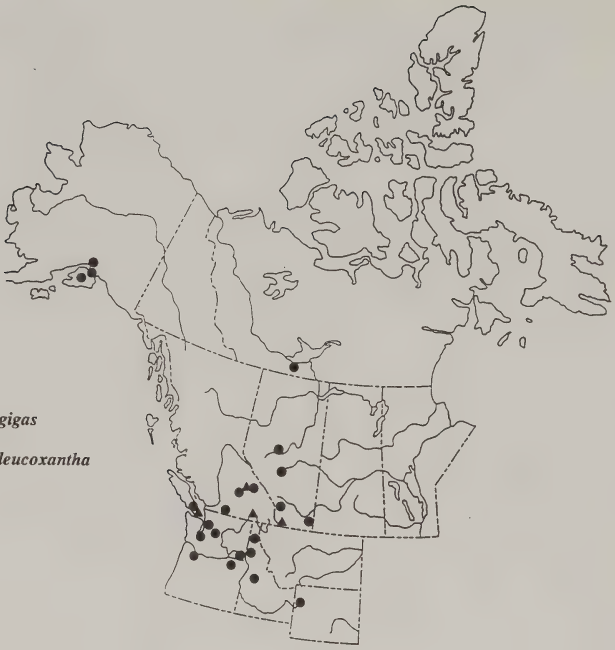
● *Gyromitra ambigua*

▲ *Gyromitra olympiana*

Map 4:



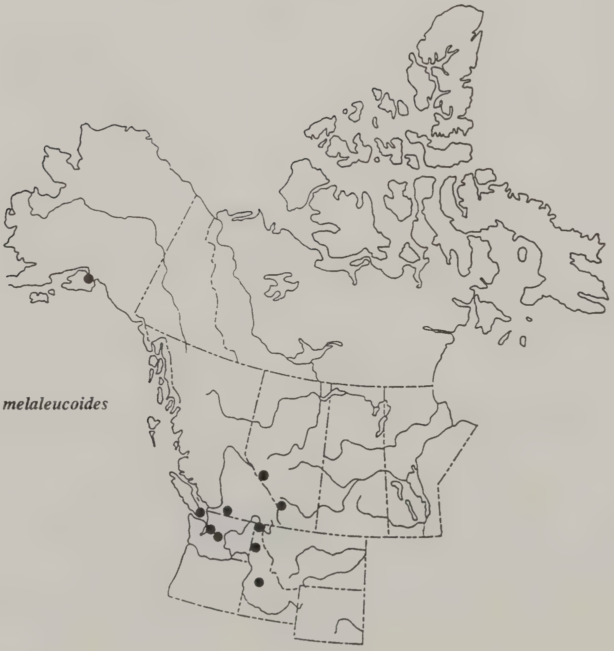
● *Gyromitra perlata*



Map 5:

● *Gyromitra gigas*

▲ *Gyromitra leucoxantha*

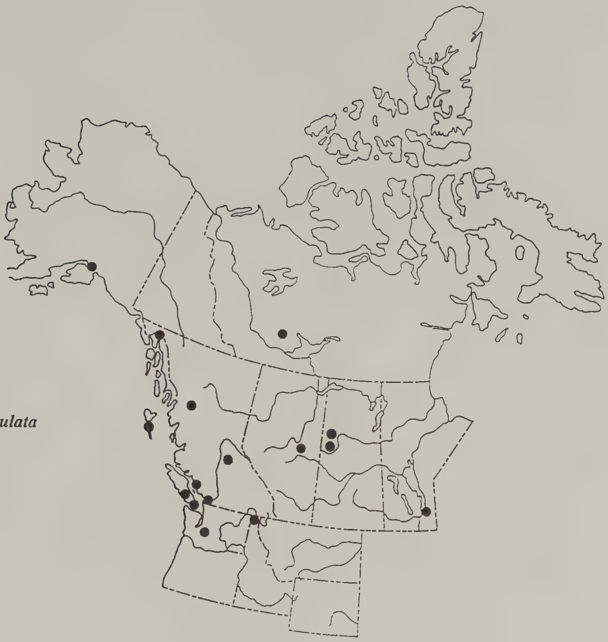


Map 6:

● *Gyromitra melaleucoides*

Map 7:

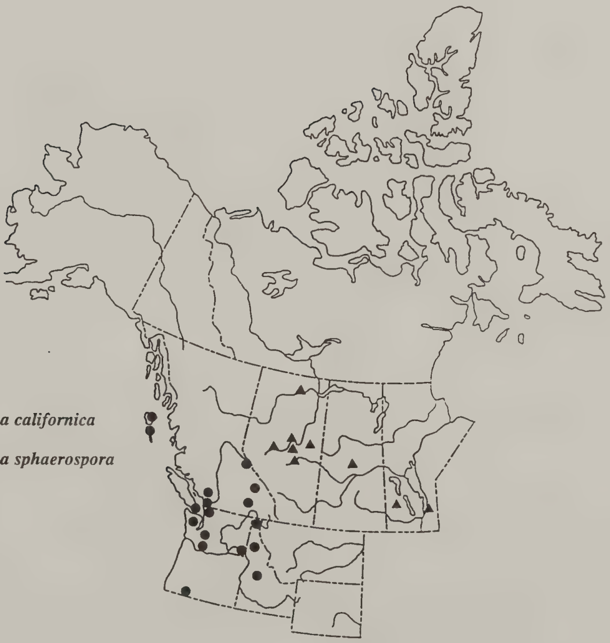
● *Rhizina undulata*



Map 8:

● *Pseudorhizina californica*

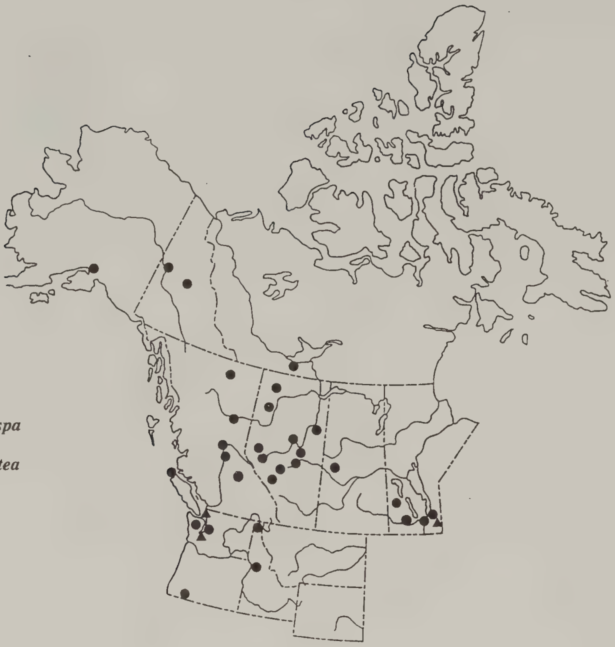
▲ *Pseudorhizina sphaerospora*



Map 9:

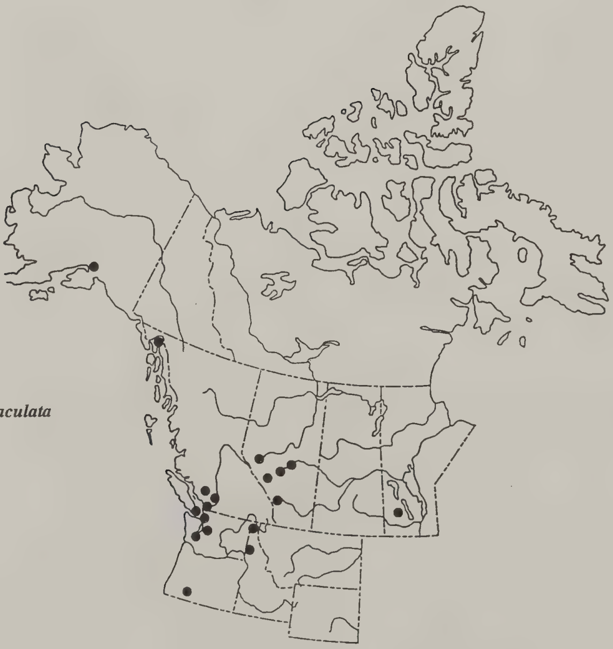
● *Helvella crispa*

▲ *Helvella lactea*



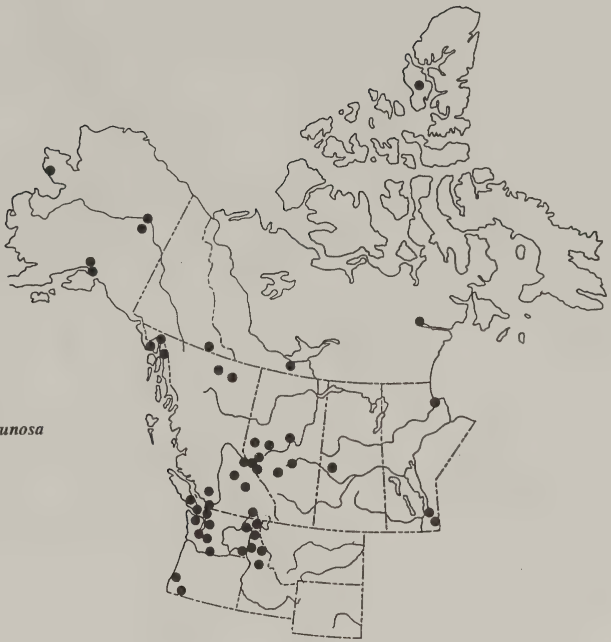
Map 10:

● *Helvella maculata*



Map 11:

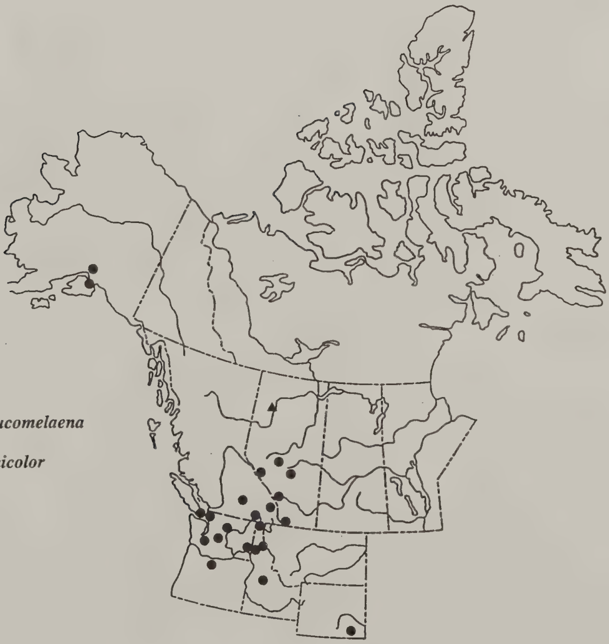
● *Helvella lacunosa*

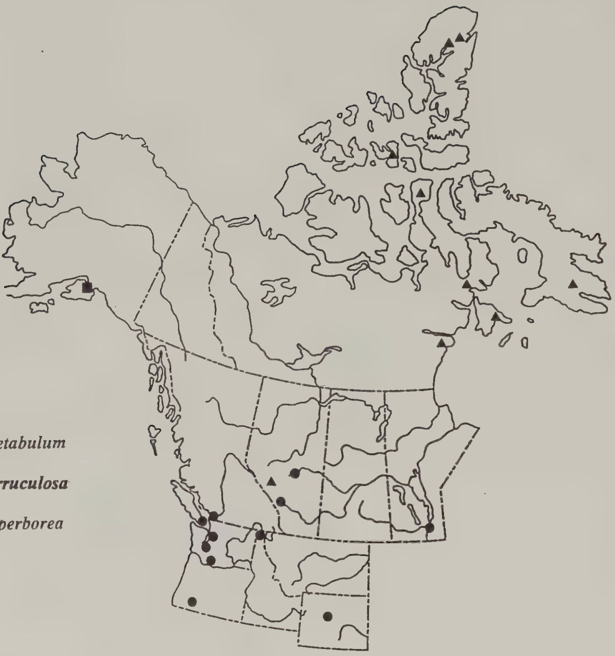


Map 12:

● *Helvella leucomelaena*

▲ *Helvella unicolor*



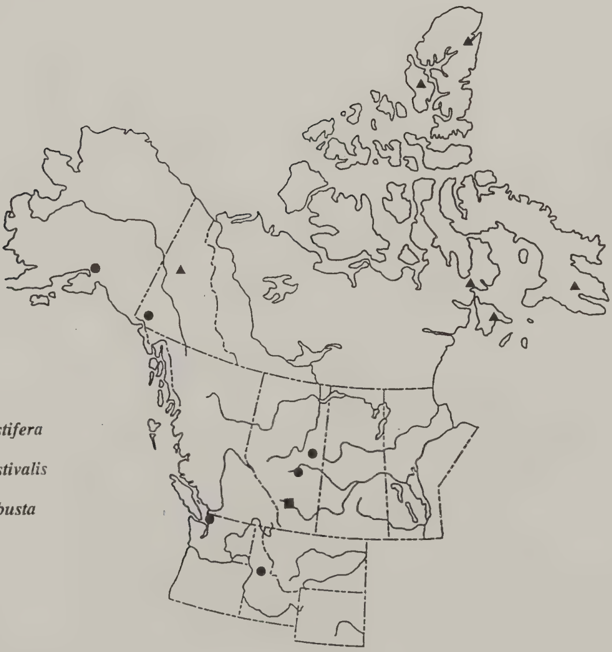


Map 13:

● *Helvella acetabulum*

▲ *Helvella verruculosa*

■ *Helvella hyperborea*



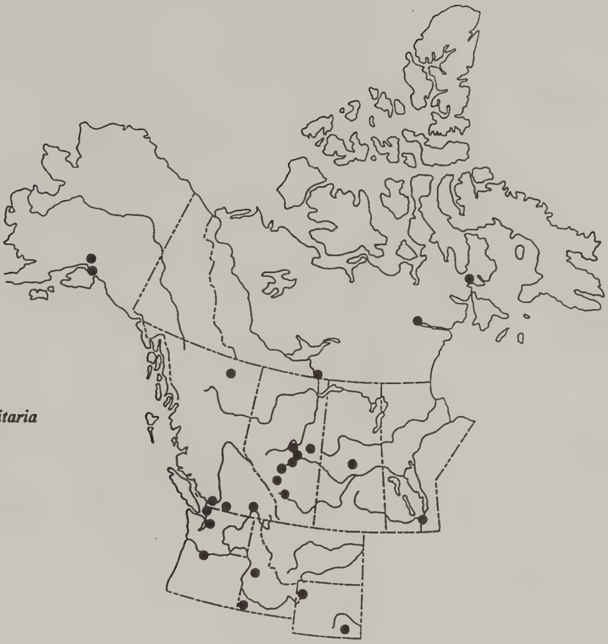
Map 14:

● *Helvella costifera*

▲ *Helvella aestivalis*

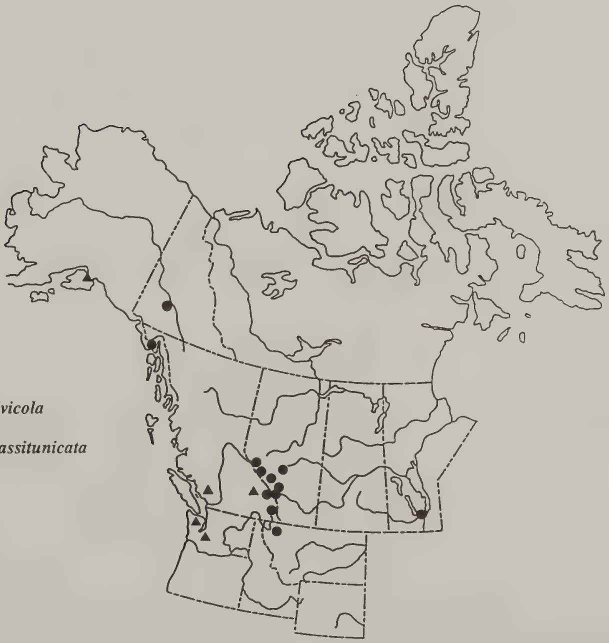
■ *Helvella robusta*

Map 15:



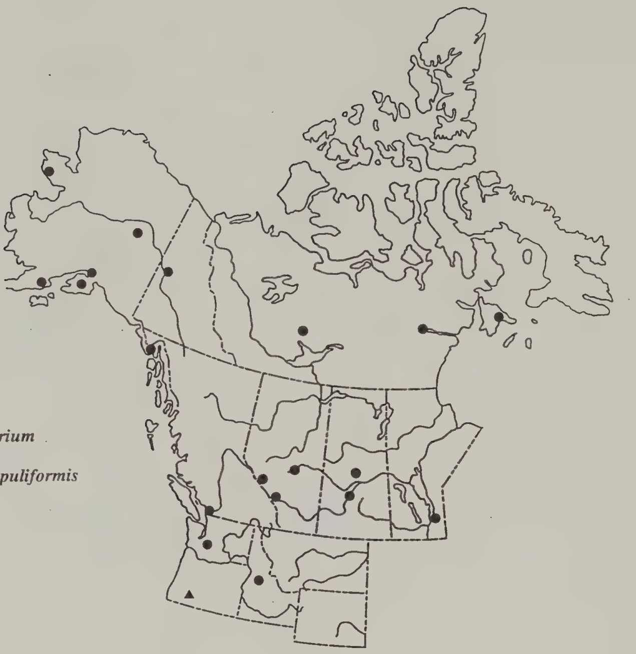
● *Helvella solitaria*

Map 16:



● *Helvella silvicola*

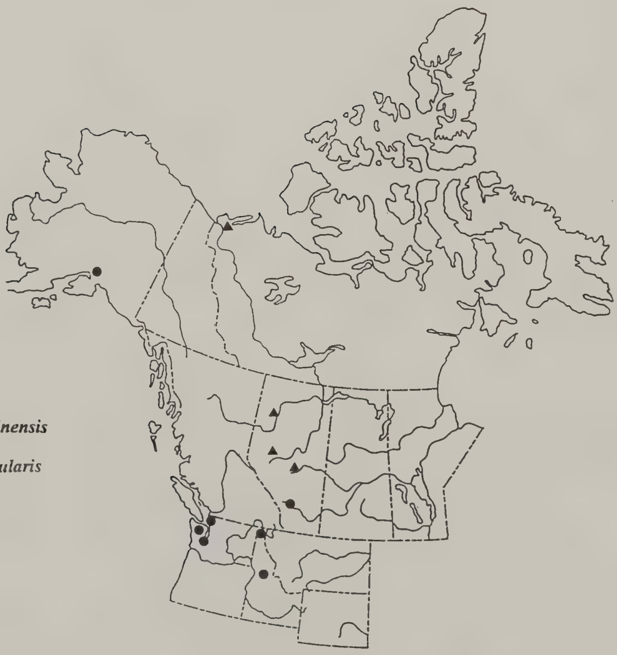
▲ *Helvella crassitunicata*



Map 17:

● *Helvella corium*

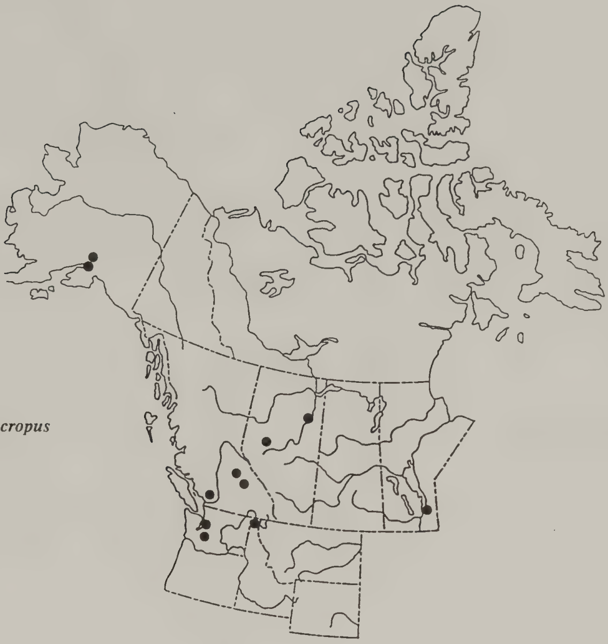
▲ *Helvella cupuliformis*



Map 18:

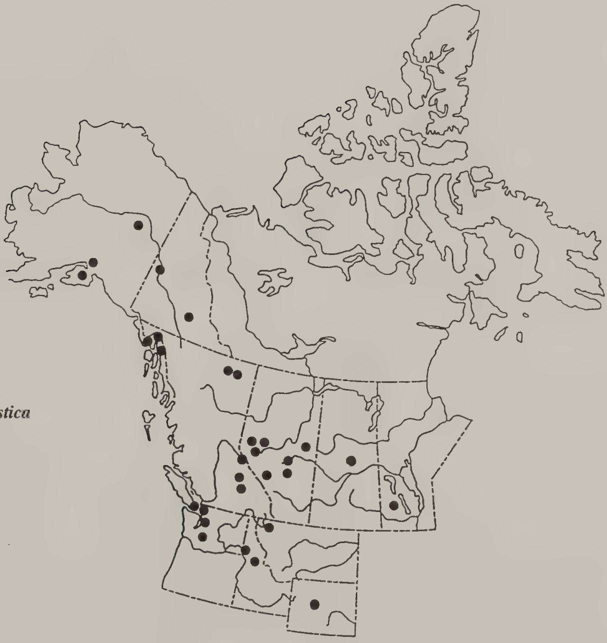
● *Helvella chinensis*

▲ *Helvella rivularis*



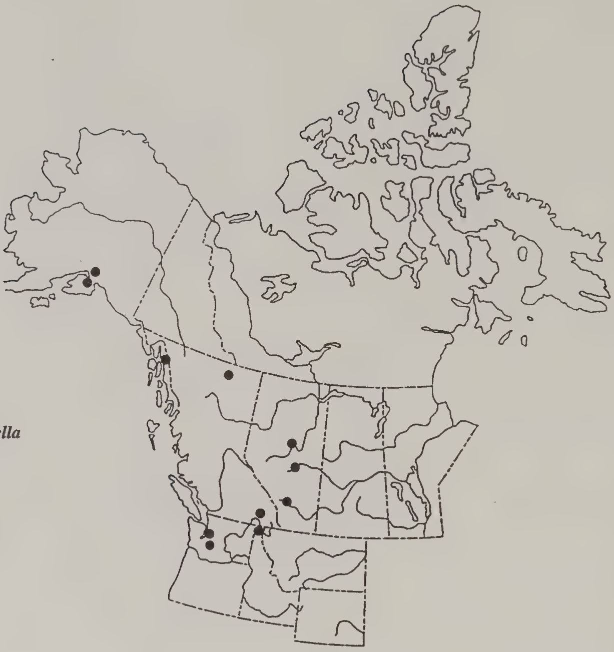
Map 19:

● *Helvella macropus*



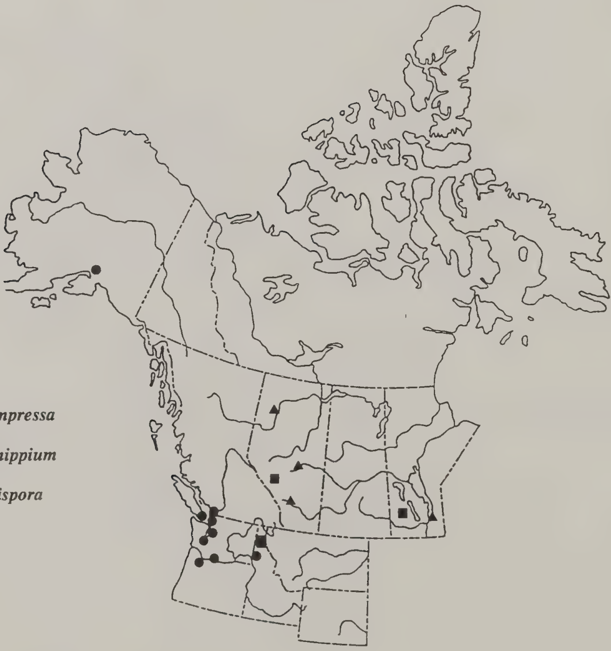
Map 20:

● *Helvella elastica*



Map 21:

● *Helvella albella*



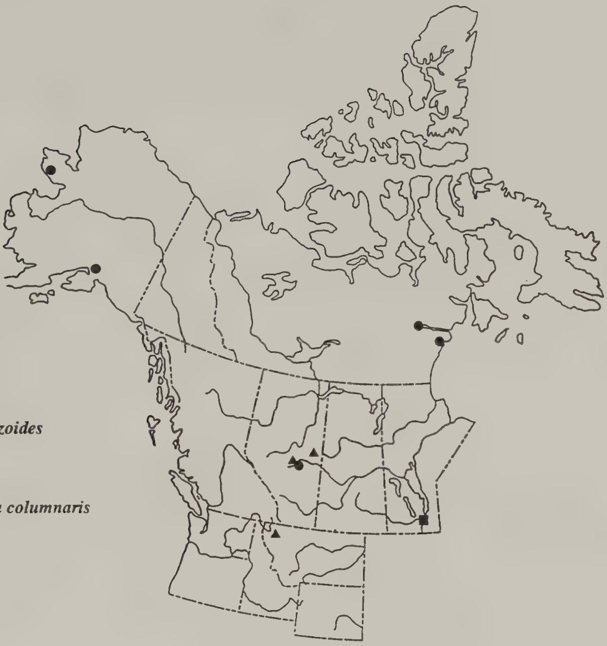
Map 22:

● *Helvella compressa*

▲ *Helvella ephippium*

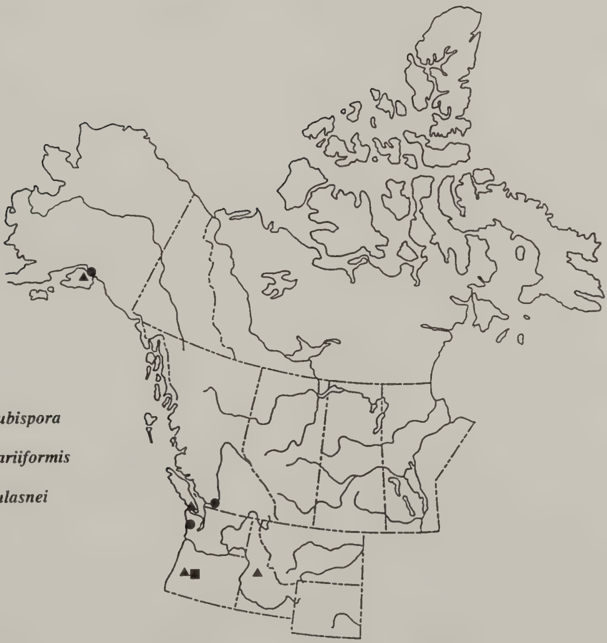
■ *Helvella latispora*

Map 23:

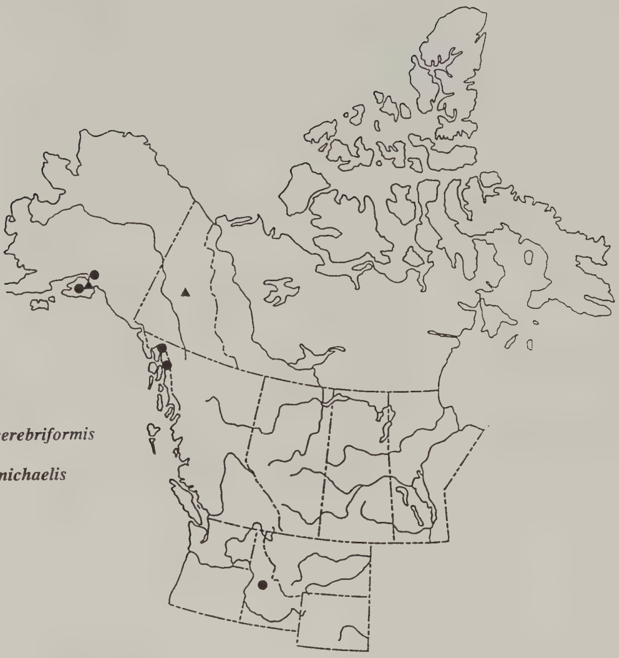


- ● *Helvella pezizoides*
- ▲ *Helvella atra*
- ■ *Underwoodia columnaris*

Map 24:



- ● *Hydnotrya cubispora*
- ▲ *Hydnotrya variiformis*
- ■ *Hydnotrya tulasnei*



Map 25:

● *Hydnotrya cerebriformis*

▲ *Hydnotrya michaelis*

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TAXONOMICAL STUDIES ON USTILAGINALES. XV. *

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ABSTRACT

The following groups of Ustilaginales were studied: the genus *Macalpinomyces*, which was emended to include *Endosporisorium*; smut fungi of the genera *Schmidtia, Polytrias, Spodiopogon* and *Thelepogon* (Gramineae), as well as different smut fungus species.

NEW SPECIES proposed: *Sporisorium amaurae* K. & C. Vánky (type on *Polytrias amaura*, Bali); *Sporisorium elegantis* K. Vánky (type on *Thelepogon elegans*, India); *Sporisorium thelepogonis* K. Vánky (type on *Thelepogon elegans*, India); *Sporisorium themedae-cymbariae* K. Vánky (type on *Themeda cymbaria*, India); *Ustilago schmidtiae* K. Vánky (type on *Schmidtia pappophoroides*, Kenya).

NEW COMBINATIONS proposed: *Anthracoidea uleiana* (H. & P. Sydow) K. Vánky, based on *Cintractia uleiana* (type on *Carex* sp., = *Carex* aff. *bonplandii*); *Anthracoidea koeleriae* (Mundkur) K. Vánky, based on *Tilletia koeleriae* (type on "*Koeleria cristata* L.", = misnamed *Carex setigera*); *Macalpinomyces chrysopogonis* (Ahmad) K. Vánky, based on *Ustilago chrysopogonis* (type on *Chrysopogon gryllus); Macalpinomyces effusus* (H. & P. Sydow) K. Vánky, based on *Ustilago effusa* (type on *Vetiveria zizanioides*); *Macalpinomyces loudetiae* (Viennot-Bourgin) K. Vánky, based on *Sorosporium loudetiae* (type on *Loudetia arundinacea*); *Melanotaenium arthraxonis* (Thirum. & Pavgi) K. Vánky, based on *Melanotaenium brachiariae* Viegas var. *arthraxonis* (type on *Arthraxon* sp.); *Sporisorium eulaliae* (L. Ling) K. Vánky, based on *Sorosporium eulaliae* L. Ling (type on *Eulalia trispicata*); *Sporisorium flagellatum* (H. & P. Sydow & Butler) K. Vánky, based on *Sorosporium flagellatum* (type on *Ischaemum timorense*); *Sporisorium kweichowense* (Y. C. Wang) K. Vánky, based on *Ustilago kweichowensis* (type on *Spodiopogon sibiricus*); *Sporisorium monocymbii* (H. Sydow) K. Vánky, based on *Sphacelotheca*

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* Part 133 in the series "Studies in Heterobasidiomycetes" from the Botanical Institute, University of Tübingen.

monocymbii (type on *Monocymbium ceresiiforme*); *Sporisorium polytriadis* (Massee) K. Vánky, based on *Ustilago polytriadis* (type on *Polytrias praemorsa*); *Sporisorium pseudanthistiriae* (H. & P. Sydow & Butler) K. Vánky, based on *Sorosporium pseudanthistiriae* (type on *Pseudanthistiria hispida*); *Sporisorium spodiopogonis* (M. S. Patil) K. Vánky, based on *Sorosporium spodiopogonis* M. S. Patil (type on *Spodiopogon rhizophorus*).

SYNONYMS: The genus *Endosporisorium* K. Vánky (type *E. capillipedii*) is considered to be a synonym of the emended *Macalpinomyces* Langdon & Fullerton (type on *Eriachne* sp.); *Cintractia californica* Zundel (type on "*Juncus Parryi* Engelm.," = misnamed *Carex* sp.) is an *Anthracoidea* species; *Cintractia pannucea* Liro (type on *Carex bonplandii*) is a synonym of *Anthracoidea uleiana* (H. & P. Sydow) K. Vánky (type on *Carex* aff. *bonplandii*); *Sorosporium baluchistani* Ahmad (type on *Bothriochloa* sp.) is a synonym of *Sporisorium andropogonis* (Opiz) K. Vánky (type on *Dichanthium ischaemum*); *Sorosporium capillipedii* Mishra (type on *Capillipedium parviflorum*) is a synonym of *Macalpinomyces chrysopogonis* (Ahmad) K. Vánky (type on *Chrysopogon gryllus*); *Sphacelotheca pekingensis* Y. C. Wang (type on *Spodiopogon sibiricus)* is *Sporisorium abramovianum* (Lavrov) Karatygin (type on *Spodiopogon sibiricus*); *Thecaphora fimbristylidis* Mundkur & Thirumalachar (type on *Fimbristylis monostachya*) is a synonym of *Tolyposporium mauritianum* H. Sydow (type on *Fimbristylis* sp.); *Ustilago caricis-wallichianae* Thirumalachar & Pavgi is *Anthracoidea koeleriae* (Mundkur) K. Vánky (type on *Carex setigera*).

LECTOTYPE is selected for *Tolyposporium mauritianum.*

Consequence of the emendation of the genus *Macalpinomyces* for the genus *Endosporisorium.*

The study of some grass smuts raised the problem of either the recognition of several, small genera or the emendation of the monotypic genus *Macalpinomyces* Langdon & Fullerton. I preferred the second possibility and widened the circumscription of this genus (Vánky, 1996) so that it includes ovaricolous grass smuts in which not only "giant", thick-walled, solitary or grouped sterile cells are embedded in the spore masses but also groups of small, thin-walled sterile cells. Through this emendation, the genus *Macalpinomyces* came close to *Endosporisorium* K. Vánky (1995:226). Indeed, *Endosporisorium capillipedii,* the type of the genus, does not show any essential difference from the emended *Macalpinomyces*, beside the localisation of the sori in the culms of the host plants as well as the marked hypertrophy produced by all species of *Endosporisorium.* In the five known species of *Macalpinomyces* the sori are restricted to the ovaries, with pronounced hypertrophy in only one of them (*M. zonotriches* K. Vánky), a typical *Endosporisorium* character. In three of the four known *Endosporisorium* species, the sori are restricted to the culms, while in *E. loudetiae*, they comprise the considerably hypertrophied inner parts of the flowers, including the ovaries. The sorus localisation of the latter species links

Endosporisorium with *Macalpinomyces*. Recent studies revealed that in species of *Endosporisorium* (except *E. pachycarpum* (H. Sydow) K. Vánky) the spore formation is similar to that of *Macalpinomyces* and the "spore balls" described in *Endosporisorium* are actually aggregates of spores rather than true spore balls. In *Macalpinomyces eriachnes* (Thümen) Langdon & Fullerton, the type of the genus, the spores are produced in the gelatinous mass of the sporogenous hyphae, not by groups of coiled hyphae as in the *Sporisorium* species (Langdon & Fullerton, 1975, 1977). This differentiates the true spore balls (though often ephemeral) of the *Sporisorium* species from the groups of aggregated spores (which may look similar to spore balls) of *Macalpinomyces* and *Endosporisorium*.

Because of intermediate species between *Macalpinomyces* and *Endosporisorium*, and several common characters of the species of the two genera, I propose to unify *Endosporisorium* with *Macalpinomyces*. Trying to collect several smut species into possibly natural, well-delimited genera may serve smut taxonomy better than creating numerous, small, often monotypic, closely related genera.

Macalpinomyces Langdon & Fullerton, **emend.** K. Vánky

Macalpinomyces, Langdon & Fullerton, Trans. Brit. Mycol. Soc. 68:30, 1977, emend. K. Vánky, 1996:119. — *Endosporisorium* K. Vánky, 1995:226.

Smuts of Gramineae. Sori in different parts of the hosts (ovaries, culms) producing hypertrophy or not, covered by host tissues permeated by hyphae. No columella present. Sori filled with pigmented, tightly packed, polyangular spores. Sterile cells of variable size and wall-thickness, singly or grouped, hyaline or pale coloured are embedded and scattered in the spore mass. At maturity, the spore mass desintegrates into irregular groups of variable size or into single spores. Spore germination of *Ustilago*-type. Typus generis: *Macalpinomyces eriachnes* (Thümen) Langdon & Fullerton.

The emended genus *Macalpinomyces* comprises 8 species: 1. *M. eragrostiellae* K. & C. Vánky, on *Eragrostiella*, India. 2. *M. eriachnes* (Thümen) Langdon & Fullerton, on *Eriachne* spp., Australia. 3. *M. sharmae* K. Vánky, on *Panicum* and *Setaria*, India. 4. *M. tripogonis* (M. S. Patil) K. Vánky, on *Tripogon* spp., India. 5. *M. zonotriches* K. Vánky, on *Zonotriche*, Rhodesia.

6. ***Macalpinomyces chrysopogonis*** (Ahmad) K. Vánky, **comb. nov.**
Basionym: *Ustilago chrysopogonis* Ahmad, Mycol. Pap. 64:2, 1956. — Type on *Chrysopogon gryllus* (L.) Trin., Pakistan.

Sorosporium capillipedii J. N. Mishra. — *Endosporisorium capillipedii* (J. N. Mishra) K. Vánky. — Type on *Capillipedium parviflorum* (R. Br.) Stapf, India.

7. ***Macalpinomyces effusus*** (H. & P. Sydow) K. Vánky, **comb. nov.**
Basionym: *Ustilago effusa* H. & P. Sydow, in H. & P. Sydow & Butler, Ann. Mycol. 4:425, 1906. — *Endosporisorium effusum* (H. & P. Sydow) K. Vánky. — Type on *Vetiveria zizanioides* (L.) Nash, India.

8. ***Macalpinomyces loudetiae*** (Viennot-Bourgin) K. Vánky, **comb. nov.** Basionym: *Sorosporium loudetiae* Viennot-Bourgin, Rev. Mycol., Suppl. Colon. 16:104, 1951; Ann. Epiphyt. 2:468, 1951. — *Endosporisorium loudetiae* (Viennot-Bourgin) K. Vánky. — Type on *Loudetia arundinacea* (Hochst. ex A. Rich.) Steudel, Cameroon.

Within the *Macalpinomyces* — *Endosporisorium* group, *E. pachycarpum* (H. Sydow) K. Vánky (*Sorosporium pachycarpum* H. Sydow, *Tolyposporella pachycarpa* (H. Sydow) L. Ling, on *Rottboellia ophiuroides* Benth., New Guinea) represents an exception. In this species, the large, rounded, thick-walled, dark spores, which are produced in the hypertrophied culms, form true spore balls. Sterile cells between the spore balls are lacking. These characters do not fit with the concept of the emended *Macalpinomyces*. For the present it is best to retain it in the genus *Tolyposporella*.

Key to the recognised *Macalpinomyces* species.

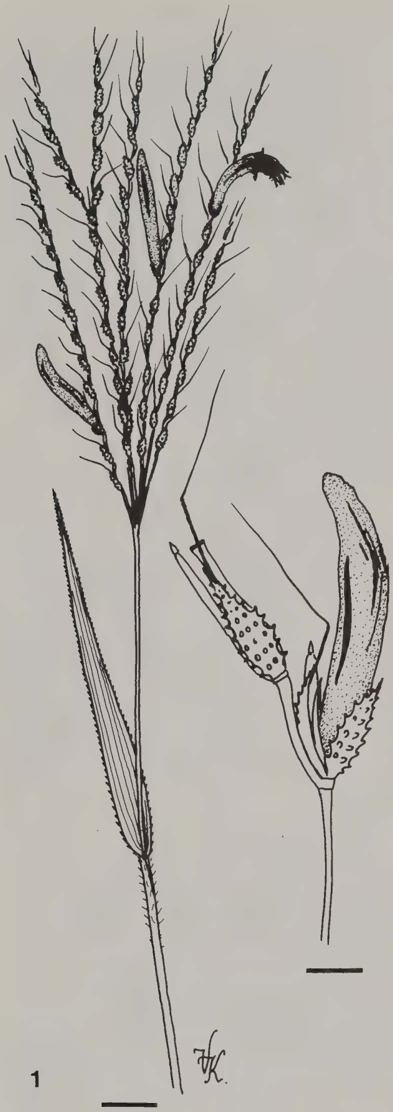
1. Sori in the ovaries 2
– Sori elsewhere 6
2. Sori considerably hypertrophied. On *Zonotriche* .... *M. zonotriches*
– Sori not or only little hypertrophied. 3
3. Sterile cells up to 32 µm long, thick-walled (up to 5 µm). On *Eriachne* .... *M. eriachnes*
– Sterile cells less than 18 µm long, thin-walled (0.5–1 µm) 4
4. Sterile cells 5–9.5 µm long. On *Eragrostiella* .... *M. eragrostiellae*
– Sterile cells larger 5
5. Sterile cells 8–10(–14) µm long. On *Tripogon* .... *M. tripogonis*
– Sterile cells 11–17 µm long. On *Panicum* or *Setaria* .... *M. sharmae*
6. Sori in the hypertrophied flowers. Spores apparently smooth to finely punctate. On *Loudetia* .... *M. loudetiae*
– Sori in the stems. Spores evidently ornamented 7
7. Spores 4–6.5 µm long, verrucose. On *Vetiveria* .... *M. effusus*
– Spores 8–11 µm long, echinulate. On *Chrysopogon* and *Capillipedium* .... *M. chrysopogonis*

Two new smut fungi of *Thelepogon* (Gramineae).

Among smut fungi collected in India, there were two undescribed species on *Thelepogon elegans* Roemer & Schultes, the sole representative of the genus *Thelepogon* (subfam. Panicoideae, tribe Andropogoneae, subtribe Ischaeminae).

Sporisorium thelepogonis K. Vánky, **sp. nov.**

Typus in matrice *Thelepogon elegans* Roemer & Schultes, India, Madhya Pradesh, Ujjain, 26.III.1966, coll. S. K. Chauhan. Holotypus in IMI 119251, isotypus in Herbario Ustil. Vánky (HUV 17400!).



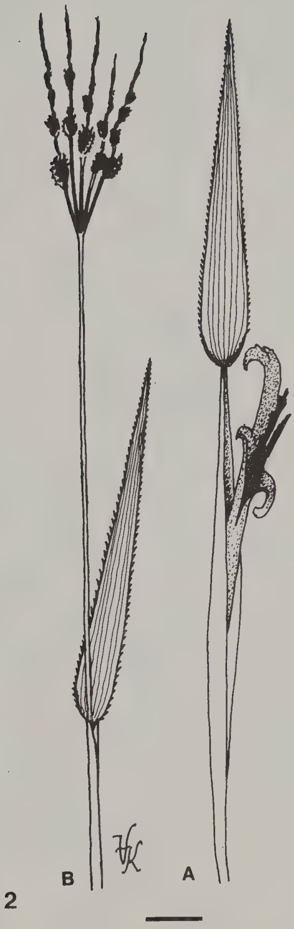


Fig. 1. Sori of *Sporisorium thelepogonis* K. Vánky in some ovaries of an inflorescence of *Thelepogon elegans* Roemer & Schultes. Enlarged two spikelets, one with a sorus (type). Bars = 1 cm and 3 mm, respectively.

Fig. 2. Sori of *Sporisorium elegantis* K. Vánky, in the spikelets, racemes and whole inflorescence of *Thelepogon elegans* Roemer & Schultes (A. type, B. paratype, HUV 17402). Bar = 1 cm.

Sori (Fig. 1) in ovariis valde tumefactis, illis nonnulla ovaria tantum eiusdem inflorescentiae affecta, cylindrici vel curvati, apice subacuti, 3–4 x cca. 20 mm, peridio crasso, pallide flavidobrunneo, origine imprimis fungali cooperti, eodem irregulariter discisso massam atrobrunneam, granuloso-pulveream glomerulorum sporarum et columellas nonnullas filiformes ostendentes. Glomeruli sporarum (Fig. 3) forma magnitudineque variabiles, subglobosi, ellipsoidales, elongati vel plerumque irregulares, 45–130 x 60–180 µm, atro-rufobrunnei, e sporis permultis (pluries decem usque pluries centum), magis permanenter agglutinatis compositi. Sporae (Figg. 3, 4) subglobosae, ovoideae usque subpolyedrice irregulares, 8–11 x 9–13,5 µm, externae earum flavido- usque pallide rufobrunneae; pariete cca. 0,5–1 µm crasso, superficie libera sporae dense verrucoso-echinulato, verrucae usque 1,5 µm altis, internae autem parum minores quam externae, pallide flavidobrunneae, pariete tenui (usque cca. 0,5 µm), conspicue levi usque subtilissime punctato-verruculoso. Cellulae steriles inter sporas absentes.

Sori (Fig. 1) in considerably swollen ovaries, affecting only some of the ovaries in the inflorescence, cylindrical or curved with subacute tips, 3–4 x ca. 20 mm, covered by a thick, light yellowish-brown peridium of mainly fungal origin which splits irregularly to disclose the dark brown, granular-powdery mass of spore balls and several filiform columellae. Spore balls (Fig. 3) variable in shape and size, subglobose, ellipsoidal, elongated or usually irregular, 45–130 x 60–180 µm, dark reddish-brown, composed of a great number (tens to hundreds) of rather permanently agglutinated spores. Spores (Figs. 3, 4) subglobose, ovoid to subpolyhedrally irregular, 8–11 x 9–13.5 µm, outer spores yellowish- to light reddish-brown, with ca. 0.5–1 µm thick wall, densely verrucose-echinulate on the free surface of the spores, warts up to 1.5 µm high, inner spores somewhat smaller than the outer ones, pale yellowish-brown, wall thin (up to ca. 0.5 µm), apparently smooth to very finely punctate-verruculose. Sterile cells between the spores absent.

Sporisorium elegantis K. Vánky, **sp. nov.**

Typus in matrice *Thelepogon elegans* Roemer & Schultes, India, Maharashtra State, 36 km N.W. urbe Pune, pr. National Defence Academy, alt. 610 m, 28.X.1992, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky (HUV 17656!). Paratypi: India, 26.III.1966, leg. Chauhan, IMI 119252, HUV 17401!; Nigeria, 1959, leg. E. Harris (537), IMI 78605, HUV 17402!

Sori (Fig. 2) spiculas, racemos vel totam inflorescentiam destruentes, et in casu ultimo in vagina folii partim inclusi. Sori in spiculis magnitudine mm-orum nonnullorum, in inflorescentia usque 3 x 30 mm, primo peridio fungali cooperti,

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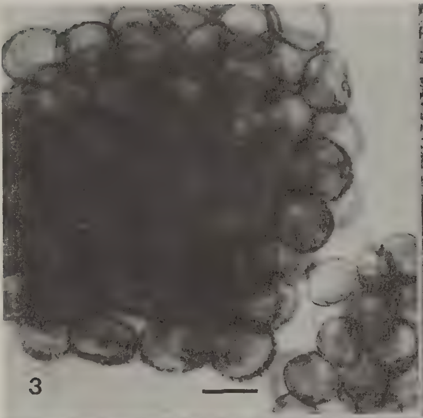
Figs. 3, 4. Spore balls and spores of *Sporisorium thelepogonis* K. Vánky in LM and in SEM (type). Bars = 10 µm.

Figs. 5, 6. Spores and sterile cells of *Sporisorium elegantis* K. Vánky in LM and in SEM (paratype, HUV 17401). Bars = 10 µm.

Figs. 7, 8. Spores of *Ustilago schmidtiae* K. Vánky in LM and in SEM (type). Bars = 10 µm.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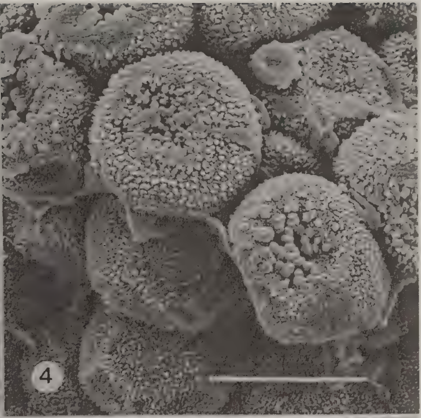
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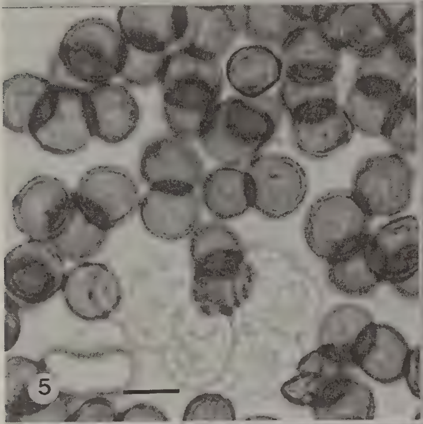
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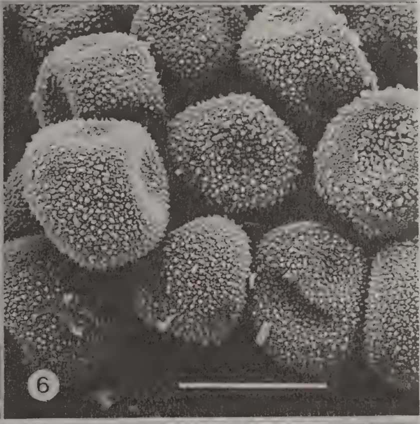
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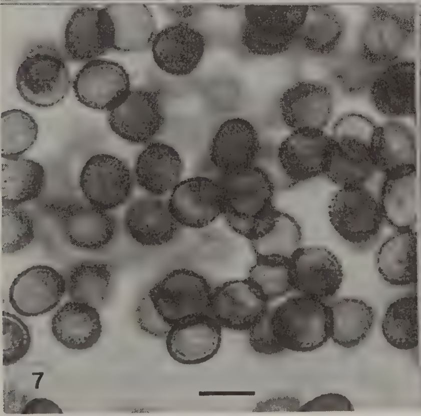
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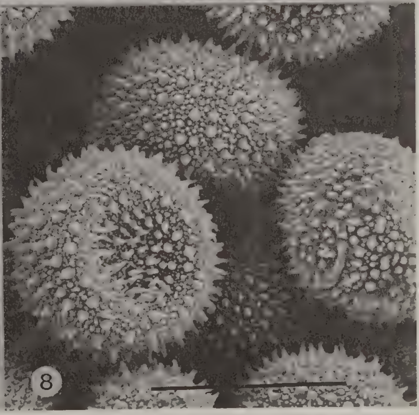
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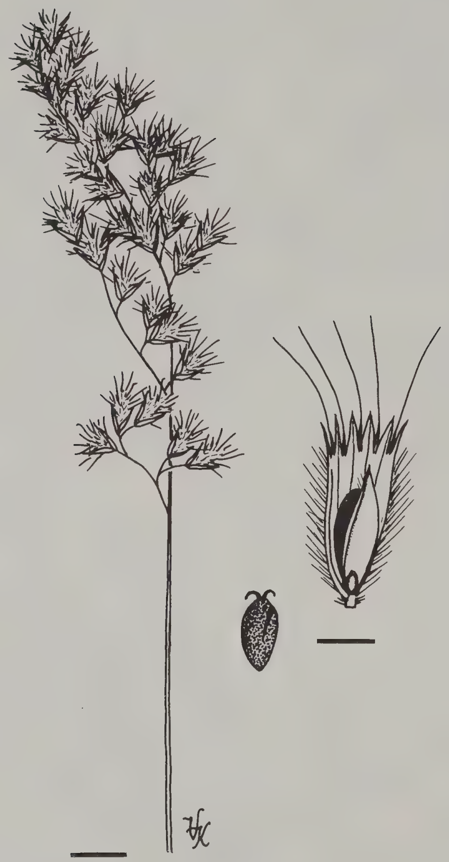

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Fig. 9. Sori of *Ustilago schmidtiae* K. Vánky in the seeds of *Schmidtia pappophoroides* Steudel ex J. A. Schmidt. Enlarged a flower with a sorus and, removed, a mature sorus (type). Bars = 1 cm and 2 mm, respectively.

illo dissoluto massam atro-chocolatabrunneam simul cum catervis cellularum sterilium et una cum columella centrali saepe ramulis brevibus lateralibus instructa intermixtam ostendentes. Glomeruli sporarum mature in sporas singulas dissoluti. Sporae (Figg. 5, 6) globosae, subglobosae, ovoideae usque parum irregulares, 9,5–12 x 9,5–13,5 µm flavidobrunneae; pariete uniformi, cca. 1 µm crasso, subtiliter, dense, uniformiter punctato-echinulato, lineam externam sporae valde subtiliter serrulatam efficienti. Cellulae steriles (Fig. 5) in catervis irregularibus vel in catenis, forma magnitudineque variables, cum lateribus contingentibus deplanatis et latere libero convexo, diametro 6,5–16 µm, in speciminibus veteris collapsae, subhyalinae usque pallide flavae, pariete 1–1,5 µm crasso, levi.

Sori (Fig. 2) destroying the spikelets, the racemes or the whole inflorescence, in the last case partly enclosed in the leaf sheath. Size of the sori from a few mm in the spikelets up to 30 mm long and 3 mm wide in the inflorescence, first covered by a fungal peridium which flakes away disclosing the dark chocolate-brown mass of spores intermixed with groups of sterile cells and a central columella often with short lateral branches. Spore balls early disintegrating into single spores. Spores (Figs. 5, 6) globose, subglobose, ovoid to slightly irregular, 9.5–12 x 9.5–13.5 µm, yellowish-brown; wall uniform, ca. 1 µm thick, finely, densely, uniformly punctate-echinulate thus spore profile very finely serrulate. Sterile cells (Fig. 5) in irregular groups or chains, variable in shape and size, with flattened contact sides and rounded free side, 6.5–16 µm in diameter, collapsed in old specimens, subhyaline to pale yellow, wall 1–1.5 µm thick, smooth.

A new smut fungus on *Schmidtia* (Gramineae).

Amoung specimens obtained from the late Prof. Zambettakis there was a smut fungus on *Schmidtia pappophoroides* Steudel ex J. A. Schmidt (subfam. Chloridoideae, tribe Pappophoreae). No smut fungus was earlier reported on *Schmidtia.* The smut fungus on *Schmidtia* is different from the smut fungi reported on other members of the tribe Pappophoreae (*Cottea, Enneapogon, Kaokochla* and *Pappophorum)* which are: 1. *Ustilago modesta* H. Sydow, 1935:231, type on *Enneapogon brachystachyus* (Jaub. & Spach) Stapf (= *E. desvauxii* Beauv.), Union of South Africa, 2. *Ustilago pappophori* Patouillard, 1906:199, type on *Pappophorum scabrum* (Lehm.) Kunth (= *Enneapogon scaber* Lehm.), Algeria, and 3. *Ustilago enneapogonis* G. W. Fischer, 1952:8, type on *Enneapogon desvauxii* Beauv. (*Pappophorum wrightii* Wats.), USA. The smut fungus on *Schmidtia* is described as:

Ustilago schmidtiae K. Vánky, **sp. nov.**

Typus in matrice *Schmidtia pappophoroides* Steudel ex J. A. Schmidt, Africa, Kenya, Makueni, alt. 3500 feet, I.1960, leg. A. V. Bogdan. Holotypus in Herbario Ustil. Vánky (HUV 17383!). Isotypi in Herb. Dept. Agric., Nairobi (3150) and in IMI (82029).

Sori (Fig. 9) in ovariis, lemma et palea perfecte obtecti, ovoidei, cca. 1,5 x 2–3 mm, atrobrunnei, tenui membrana pericarpii cooperti, eadem rupta massam sporarum nigrobrunneam, primo semiagglutinatam, serius pulveream ostendentes. Sporae (Figg. 7, 8) globosae, subglobosae, ovoideae usque ellipsoidales, 8–10,5 x 9–12 µm, mediocriter rufobrunneae; pariete tenui (cca. 0,7 µm), aequali, moderate dense, uniformiter, subtiliter echinulato, lineam externam sporae subtiliter serrulatam efficienti. Columella et cellulae steriles inter sporas absentes.

Sori (Fig. 9) in ovaries, completely hidden by the lemma and palea, ovoid, ca. 1.5 x 2–3 mm, dark brown, covered by a thin membrane of the pericarp which ruptures disclosing the blackish-brown, first semi-agglutinated, later powdery mass of spores. Spores (Figs. 7, 8) globose, subglobose, ovoid to ellipsoidal, 8–10.5 x 9–12 µm, medium reddish-brown; wall thin (ca. 0.7 µm), even, moderately densely, uniformly, finely echinulate, giving the spore profile a finely serrulate aspect. Columella and sterile cells between the spores absent.

The smut fungi of *Polytrias* (Gramineae).

The monotypic genus *Polytrias* from Southeast Asia belongs to the subfam. Panicoideae, tribe Andropogoneae, subtribe Saccharinae (Clayton & Renvoize, 1986). On *Polytrias amaura* (Büse) O. Kuntze (*Andropogon amaura* Büse; *Pollinia praemorsa* Nees ex Steudel; *Polytrias praemorsa* (Nees) Hack.; *Eulalia praemorsa* (Nees) Stapf ex Ridley) only one smut fungus is known which belongs to the genus *Sporisorium*:

Sporisorium polytriadis (Massee) K. Vánky, **comb. nov.**

Basionym: *Ustilago polytriadis* Massee, Bull. Misc. Inform. 1911:224, 1911. — *Sphacelotheca polytriadis* (Massee) L. Ling, 1949:127. — Type on *Polytrias praemorsa* (Nees) Hack. (= *P. amaura* (Büse) O. Kuntze), Malay Peninsula, Malacca, XII.1899 (K).

Sori in ovaries, ovoid to ellipsoidal, ca. 1 x 1.5–2 mm, first covered by a light brown fungal peridium which ruptures disclosing the dark brown, powdery mass of spore balls and a simple, delicate, central columella. Spore balls many-spored, subglobose, elongate to irregular, 45–70 x 55–95 µm, dark reddish-brown, when mature easily disintegrating into single spores. Spores slightly irregular, subpolyhedrally globoid or ovoid, 9.5–13.5 x 10.5–16 µm, reddish-brown; wall unevenly thickened, 0.8–2.5 µm wide, from apparently smooth to very finely punctate-echinulate.

Type not seen, only a specimen from Singapore, 31.VII.1959, A. Thompson (IMI 77632), in which the spore measurements agree with the original description.

On the same host plant a different smut fungus was collected in Bali:

Sporisorium amaurae K. & C. Vánky, **sp. nov.**

Typus in matrice *Polytrias amaura* (Büse) O. Kuntze, Indonesia, Island of Bali, 25 km S.S.W. urbe Denpasar, pr. pag. Pecatu, 8°51' S, 115°09' E, 2.IV.1992, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky (HUV 17399), isotypi in Vánky, Ust. exs. No. 963 (unacum *Sporisorium polytriadis* (Massee) K. Vánky).

Sori (Fig. 10) in omnibus spiculis inflorescentiae eas perfecte corrumpantes, ovoidei vel cylindrici, 1–1,5 x 1,5–4(–5) mm, primo peridio flavido-brunneo cooperti, illo irregulariter rupto massam atrobrunneam, pulveream sporarum, intermixtam cum glomis cellularum sterilium et una columella simplici vel breviter ramosa centrali. Sporae (Figg. 12, 13) maturitate singulae, subglobosae, ovoideae usque parum irregulares, 7–9,5 x 8–10,5 µm, flavidobrunneae; pariete uniformi, cca. 0,8 µm crasso, valde subtiliter punctato, sub SEM minute verruculoso, inter verrucas minute, dense punctato. Cellulae steriles forma magnitudineque variables, subglobosae, subcuneiformes vel irregulares, lateribus contingentibus depressae, 6,5–12 x 6,5–17 µm, subhyalinae, pariete 0,5–0,8 µm crasso, levi.

Sori (Fig. 10) in all spikelets of an inflorescence, completely destroying them, ovoid or cylindrical, 1–1.5 x 1.5–4(–5) mm, first covered by a yellowish-brown peridium which ruptures irregularly disclosing the dark brown, powdery mass of spores intermixed with groups of sterile cells and a simple or shortly ramified central columella. Spores (Figs. 12, 13) when mature single, subglobose, ovoid to slightly irregular, 7–9.5 x 8–10.5 µm, yellowish-brown; wall uniform, ca. 0.8 µm thick, very finely punctate, in SEM finely verruculose, between the warts minutely, densely punctate. Sterile cells variable in shape and size, subglobose, subcuneiform or irregular, with flattened contact sides, 6.5–12 x 6.5–17 µm, subhyaline; wall 0.5–0.8 µm thick, smooth.

Sporisorium amaurae differs from *S. polytriadis* especially in the size of the spores and thickness of the spore wall. These two smuts were also compared with the sole known smut on the genus *Eulalia* which is closely related to *Polytrias*.

Sporisorium eulaliae (L. Ling) K. Vánky, **comb. nov.**

Basionym: *Sorosporium eulaliae* L. Ling, Sydowia 7:155, 1953. — Type on *Eulalia trispicata* (Schultes) Henrard (*Eulalia argentea* Brongn.), Australia, Queensland, N. of Mackay, 21.VIII.1941, R. F. Langdon. Holotype in IMI (43721), isotype in BPI (179840!).

Sori in ovaries, infecting all spikelets of the inflorescence, fusiform-ellipsoidal, 0.5–1 x 4–5 mm, partly hidden by the glumes, first covered by a brown peridium which lacerates into strips exposing the dark brown, granular-powdery mass of spore balls surrounding a filiform, simple or shortly ramifying, central columella. Spore balls globose, ellipsoidal to oblong or slightly irregular, 30–75 x 33–90 µm, dark reddish-brown, composed of tens of spores which separate rather easily at maturity. Spores variable in shape, size and appearance depending on their position in the spore ball. Peripheral spores subglobose, ellipsoidal, elongated or slightly irregular, 7–13 x 9–14(–15) µm, dark reddish-brown; wall thick (1–2 µm), slightly uneven, prominently, moderately densely echinulate on the free surface (spines up to 0.5–0.8 µm high), punctate-verruculose on the contact sides; inner spores subpolyhedrally irregular, 6.5–9.5 x 7–11 µm, light yellowish-brown, wall thin (ca. 0.5 µm), even, apparently smooth to very finely punctate. Sterile cells between the spores not seen.

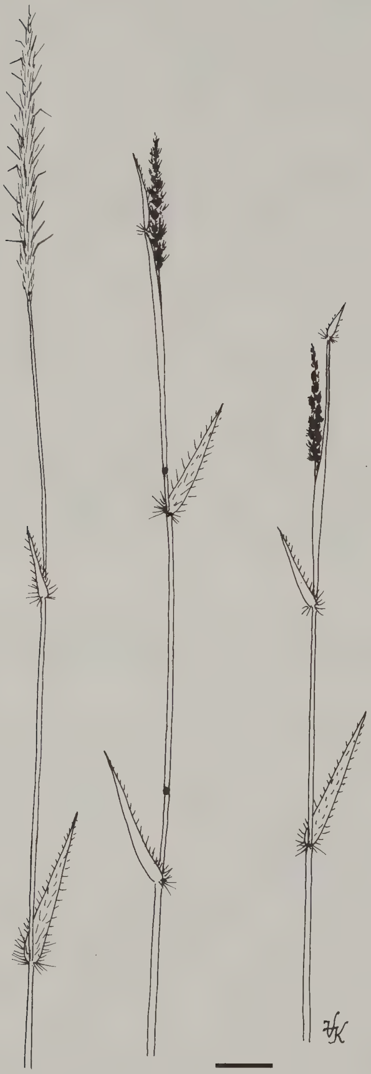

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Fig. 10. Sori of *Sporisorium amaurae* K. & C. Vánky in the spikelets of *Polytrias amaura* (Büse) O. Kuntze (type). Left a healthy plant. Bar = 1 cm.

The smut fungi of *Spodiopogon* (Gramineae).

In connection with a smut fungus collected in India on *Spodiopogon rhizophorus* (Steudel) Pilger (subfam. Panicoideae, tribe Andropogoneae, subtribe Saccharinae), I checked the reported smut fungi on this host genus. These are: 1. *Sorosporium flagellatum* H. & P. Sydow & Butler (type on *Ischaemum timorense* Kunth, = *Spodiopogon blumii* Nees ex Steudel, *S. bryonis* Trin., India), 2. *Sorosporium abramovianum* Lavrov (= *Sporisorium abramovianum* (Lavrov) Karatygin, type on *Spodiopogon sibiricus* Trin., Russia), 3. *Ustilago kweichowensis* Wang (type on *Spodiopogon sibiricus* Trin., China), 4. *Sphacelotheca pekingensis* Wang (type on *Spodiopogon sibiricus* Trin., China), 5. *Sorosporium matheranensis* R. V. Gandhe (invalidly published, on *Spodiopogon rhizophorus* (Steudel) Pilger, India), and 6. *Sorosporium spodiopogonis* M. S. Patil (as "*spondiopogonae*", type on *Spodiopogon rhizophorus* (Steudel) Pilger, India).

Of these, *Sorosporium flagellatum* and *Sorosporium spodiopogonis* show characters of the genus *Sporisorium*. *Sphacelotheca pekingensis* and *Sorosporium matheranensis* are identical with and synonyms to *Sporisorium abramovianum* and *S. spodiopogonis* respectively. The recognised species and their synonyms are:

Sporisorium flagellatum (H. & P. Sydow & Butler) K. Vánky, **comb. nov.** Basionym: *Sorosporium flagellatum* H. & P. Sydow & Butler, Ann. Mycol. 5:489, 1907. — Type on *Ischaemum timorense* Kunth (= *Spodiopogon blumii* Nees ex Steudel, *S. bryonis* Trin.), India., Wynaad, Malabar, 30.IX.1904, E. J. Butler. Isotypi in Sydow, Ust. No. 393, HUV 1667!

Sori destroying the inflorescence, covered by a yellowish-brown peridium and hidden by the terminal leaf sheath from which a long (up to 5 cm or longer), twisted, flagelliform columella is protruding. At maturity the peridium ruptures disclosing the blackish-brown, granular-powdery mass of spore balls intermixed with groups of sterile cells. Spore balls subglobose to ovoid, 25–50 x 28–65 µm, dark reddish-brown, composed of 7–30 (or more?), rather easily separating spores. Spores subglobose, ellipsoidal to irregular with somewhat flattened contact sides, 9–15(–17) x 12–19 µm, reddish-brown; wall 1–1.5 µm thick, in most of the spores with a thinner area, densely and finely verruculose-echinulate which just affects the spore profile. Sterile cells in irregular groups, collapsed in the old type specimen, single cells ca. 10–16 µm long, hyaline, thin-walled (ca. 0.5 µm), smooth.

Sporisorium spodiopogonis (M. S. Patil) K. Vánky, **comb. nov.** Basionym: *Sorosporium spodiopogonis* M. S. Patil, as "*spondiopogonae*", Indian Phytopathol. 45:181, 1992. — Type on *Spodiopogon rhizophorus* (Steudel) Pilger, India, Maharashtra State, Matheran, XI.1985, leg. S. R. Yadav. Holotypus in HCIO 30112!, isotypi in Herb. M. S. Patil, Kolhapur, India, and in HUV 17308!

Sorosporium matheranensis R. V. Gandhe, 1978:90 (invalidly published, Art. 29, ICBN). — On *Spodiopogon rhizophorus* (Steudel) Pilger, India, Maharashtra State, Matheran, 5.XI.1976, leg. S. D. Patil (HCIO 33472!).

Sori in the ovaries, usually all ovaries of a panicle infected but not all panicles of a plant affected. Infected panicles often grouped arising from excessively proliferating axillary shoots. Single sori cylindrical, 1–1.5 x 2–4 mm, first covered by a dark brown fungal peridium which early dehisces exposing the blackish-brown, granular-powdery mass of spore balls intermixed with groups of sterile cells, as well as 1–3 simple or shortly ramifying, 2–5 mm long columellae. Spore balls subglobose, ovoid, elongated or irregular, 30–65(–80) x 40–100 (–110) µm, dark reddish-brown, opaque, composed of a great number of rather easily separating spores. Spores subglobose, broadly ellipsoidal or subpolyhedrally irregular, 7–12 x 8–14 µm, reddish-brown; wall ca. 1 µm thick, densely, finely echinulate. Inner spores polyhedral, slightly lighter coloured, thin-walled, finely verruculose-echinulate. Sterile cells in irregular groups, single cells ellipsoidal, hemiglobose, subcuneiform or irregular, with flattened contact sides, 5.5–14 µm long, hyaline to pale yellow, with thin (0.8–1 µm), smooth wall.

Known hitherto only from India.

Sporisorium abramovianum (Lavrov) Karatygin, in Karatygin & Azbukina, 1989:72. — *Sorosporium abramovianum* Lavrov, 1934:85. — Type on *Spodiopogon sibiricus* Trin., Russia, East Siberia, South Ussuri Province, near Nikolsk-Ussurijskij, 7.VII.1926, leg. E. P. Kotova, and 17.VI.1927, leg. I. N. Abramov.

Sphacelotheca pekingensis Y. C. Wang, 1962:135. — Type on *Spodiopogon sibiricus* Trin., China, Beijing, 5.V.1960, Y. C. Wang, HMAS 31562, isotype HUV 12002!. Paratypes seen by me are: HMAS 19621 (HUV 12004!), HMAS 20586 (HUV 7990!), and HMAS 20587 (HUV 7989!).

Sori comprise the whole inflorescence, partly enclosed in the leaf sheath, flagelliform, 1–2 mm wide, 10–20 cm long, first covered by a brown fungal peridium which ruptures longitudinally by shorter or longer parallel fissures disclosing the dark brown, powdery mass of spore balls, spores and numerous (10–20) long, filiform, slender columellae. Spore balls subglobose, ellipsoidal, rarely elongated, 15–35 x 20–50 µm, reddish-brown, composed of a few dozen of easily separating spores. Spores globose, subglobose to broadly ellipsoidal, 5–6.5(–7) x 5.5–7.5(–8) µm, light reddish-brown; wall of the outer spores may be uneven, thicker on the free surface (1–1.5 µm), thinner on the opposite side (0.5–1 µm), prominently verrucose. The inner spores have more regular walls than the outer ones. Sterile cells few, in small irregular groups, collapsed.

I did not see any of the two syntypes of *Sporisorium abramovianum* (Lavrov), Karatygin (which have to be lectotypified). In the original description (Lavrov, 1934:85), the spore balls of this species were described to be cylindrical, measuring 23–26 x 75–120 µm. Such spore balls are certainly artefacts, produced when spores have passed intestinal tracts of insects. Also in *Sorosporium reverdattoanum* Lavrov, 1934:86, the same kind of "spore balls" was described which could be demonstrated to be artefacts (Vánky, 1985:223), produced by insects, and the fungus is actually *Ustilago minima* Arthur.

The comparison of the isotype and three of the paratypes of *Sphacelotheca pekingensis* with several specimens of *Sporisorium abramovianum* could not reveal any essential difference and therefore they are considered conspecific.

Sporisorium kweichowense (Y. C. Wang) K. Vánky, **comb. nov.**
Basionym: *Ustilago kweichowensis* Y. C. Wang, Acta Bot. Sinica 10:133, 1962. — Type on *Spodiopogon sibiricus* Trin., China, Kwei-chow, Cheheng hsian, Lung-Jin-chai, alt. 900 m, 8.X.1958, C. C. Wang (491), HMAS 31559!

Sori comprise the whole inflorescence, 2–4 cm long, first encased by leaf sheaths and covered by a yellowish-brown peridium, later protruding, the peridium rupturing, flaking away and disclosing the dark brown, semiagglutinated to powdery mass of spores intermixed with groups of sterile cells and a ramified columella of host origin. Spores subglobose, ovoid, ellipsoidal to slightly subpolyhedrally irregular, 6.5–9.5 x 7–11 µm, yellowish-brown; wall thin, ca. 0.5 µm, finely punctate-echinulate. Large, irregular groups or chains of collapsed sterile cells are abundant between the spores.

Spodiopogon bryonis Trin. is also given by Zundel (1953:95) as host plant of *Sphacelotheca ischaemi* (Fuckel) Clinton (= *Sporisorium andropogonis* (Opiz) K. Vánky, type on *Dichanthium ischaemum* (L.) Roberty). This report probably refers to *Sporisorium flagellatum*.

Key to the smut fungi (*Sporisorium*) of *Spodiopogon*.

1. Sori in the ovaries.. *S. spodiopogonis*
– Sori in the whole inflorescence..2
2. Spores 12–19 µm long, densely and finely verruculose- echinulate.
Columella one, flagelliform. .... *S. flagellatum*
– Spores smaller. Columella one, ramified or several, filiform columellae..........3
3. Spores 5.5–8 µm long, prominently verrucose. Columellae
several, filiform... *S. abramovianum*
– Spores 8–11 µm long, finely punctate-echinulate. Columella
one, ramified .... *S. kweichowense*

A new smut fungus on *Themeda* (Gramineae).

I revised the Ustilaginales of *Themeda* (Vánky, 1994b:153-165) and recognised 18 species. Recently, a smut fungus was collected on *Themeda cymbaria* which differs from all these species especially by production of witches' brooms but also by the morphology of the single sori, spores and sterile cells. It is described as:

Sporisorium themedae-cymbariae K. Vánky, **sp. nov.**
Typus in matrice *Themeda cymbaria* (Roxb.) Hack., India, Karnataka, 80 km S. Mysore, Bandipur National Park, alt. 1270 m, 5.XI.1995, leg. N. D. Sharma, C. & K. Vánky. Holotypus in Herbario Ustil. Vánky (HUV 17466!), isotypi in HCIO, BPI and in Vánky, Ust. exs. No. 973. Paratypus: India, Kerala, pr. lacum Periyar, alt. 860 m, 5.II.1980, leg. K. Vánky (HUV 9049). Isoparatypi in Vánky, Ust. exs. No. 354 (sub *Sorosporium healdii* Zundel).

Fungus fasciculos stolonum scopaeformes unum vel nonnullos inflorescentiae diametro 2–8 cm provocans (Fig. 11). Sori floribus valde deformatis restricti. Sori unusquisque involucris floralibus longis, angustis, foliis similibus circumdati.

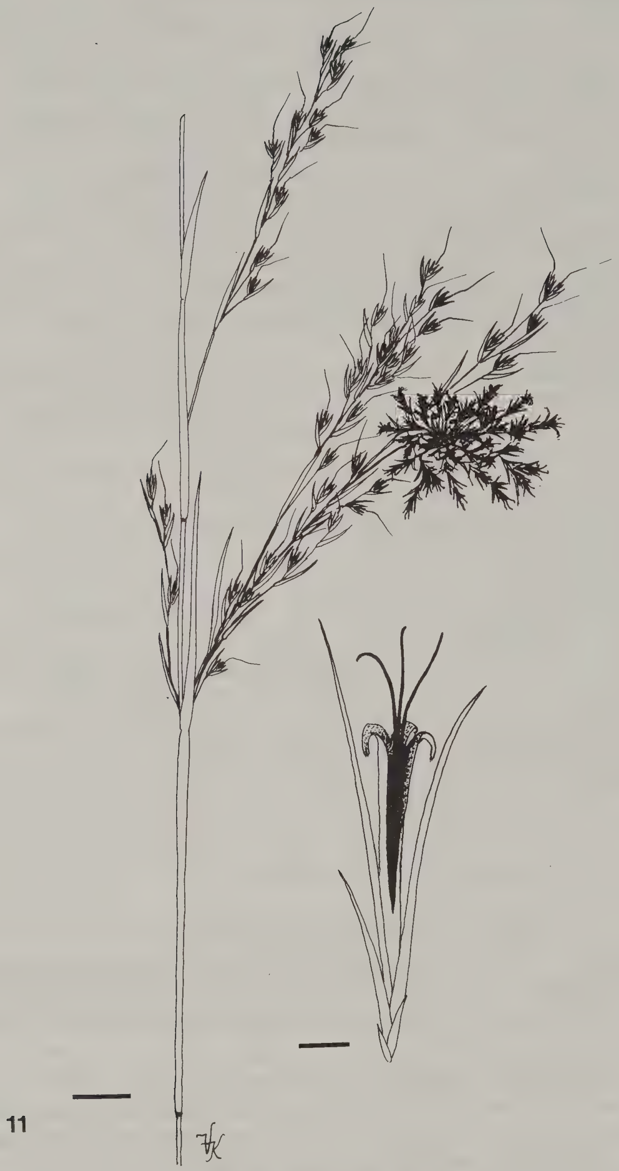
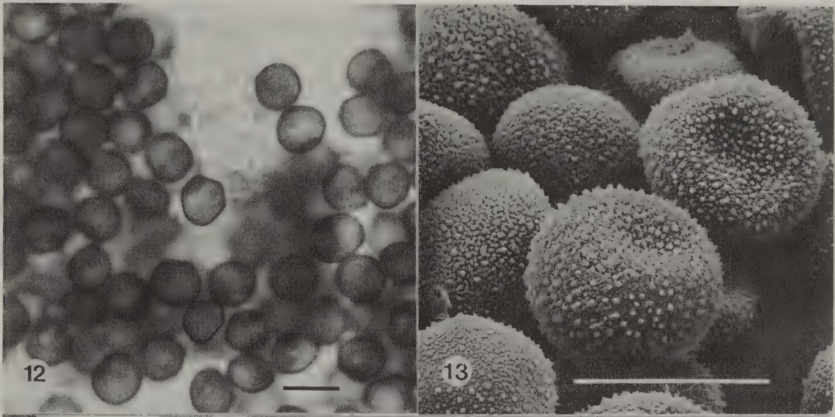
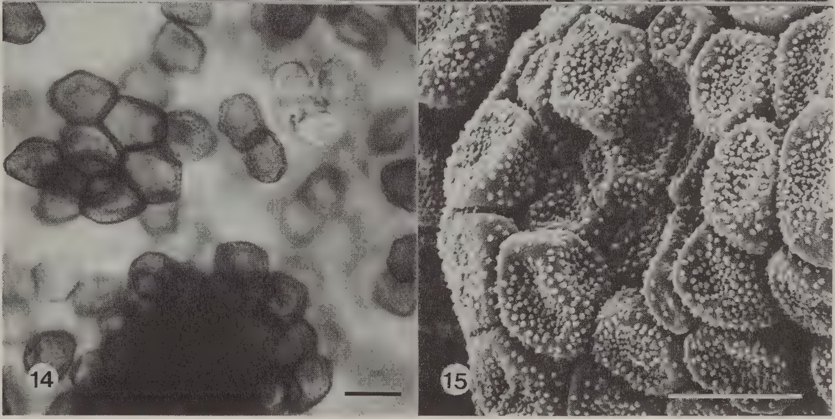


Fig. 11. Part of a panicle of *Themeda cymbaria* with sori of *Sporisorium themedae-cymbariae* K. Vánky, forming witches' brooms. Enlarged a sorus in a strongly deformed flower of the host plant (type). Bars = 1 cm and 3 mm.





Figs. 12, 13. Spores and sterile cells of *Sporisorium amaurae* K. & C. Vánky in LM and in SEM (type). Bars = 10 µm.

Figs. 14, 15. Spore balls, spores and sterile cells of *Sporisorium themedae-cymbariae* K. Vánky in LM and in SEM (type). Bars = 10 µm.

Sori cylindrici, 0,5–1 x 10–20 mm, primo peridio fungali flavido-brunneo cooperti, illo serius longitudinaliter taeniis nonnullis lacerato massam pulveream, atrobrunneam glomerulorum sporarum laxorum et columellas nonnullas (2–7) filiformes, tenues ostendentes. Glomeruli sporarum (Figg. 14, 15) subglobosi, elongati usque subpolyedrice irregulares, 30–75 x 40–120 µm, atro-rufobrunnei, opaci, e pluries decem usque pluries centum sporis, satis faciliter separabilibus compositi. Sporae (Figg. 14, 15) forma magnitudineque variables, subpolyedrice irregulares, (5,5–)6,5–13 x 6,5–14(–16) µm, flavidobrunneae usque parum

rufobrunneae; pariete uniformi, cca. 0,8 µm crasso, prominenter verrucoso, in linea extrema sporae plane conspicue. Cellulae steriles (Fig. 14) inter sporas paucae, in catervis parvis irregularibus, catenulatae vel singulae, 5–12 µm longae, pariete tenui (cca. 0,6 µm), leves, hyalinae.

The fungus produces one to several witches' brooms in the inflorescence (Fig. 11), 2–8 cm in diameter. Sori restricted to the strongly deformed flowers. Each sorus surrounded by long, narrow leaf-like floral envelopes. Sori cylindrical, 0.5–1 x 10–20 mm, first covered by a yellowish-brown fungal peridium which splits longitudinally into several bands disclosing the powdery, dark brown mass of loose spore balls and several (2–7) filiform, slender columellae. Spore balls (Fig. 14) subglobose, elongate to subpolyhedrally irregular, 30–75 x 40–120 µm, dark reddish-brown, opaque, composed of tens to hundreds of rather easily separating spores. Spores (Fig. 15) variable in shape and size, subpolyhedrally irregular, (5.5–)6.5–13 x 6.5–14(–16) µm, yellowish-brown to light reddish-brown; wall uniform, ca. 0.8 µm thick, prominently verrucose which just affects the spore profile. Sterile cells between the spores few, in small, irregular groups, in chains or single, 5–12 µm long, thin-walled (ca. 0.6 µm), smooth, hyaline.

NEW COMBINATIONS

The study of the type specimen of *Cintractia uleiana* H. & P. Sydow revealed that it is an *Anthracoidea:*

Anthracoidea uleiana (H. & P. Sydow) K. Vánky, **comb. nov.**
Basionym: *Cintractia uleiana* H. & P. Sydow, Ann. Mycol. 14:73, 1916. — Type on *Carex* sp. (= *Carex* aff. *bonplandii* Kunth, rev. K. Vánky), Brazil, Roraima, XII.1909, E. Ule (3376), BPI 172260!

This species is identical and synonymous with the later described, peculiar and typical *Cintractia pannucea* Liro, 1935:15 (*Anthracoidea pannucea* (Liro) K. Vánky), type on *Carex bonplandii* Kunth, Colombia. *A. uleiana* (*A. pannucea*) is rather common in the high mountains of Central- and South America on species of *Carex* belonging to the subgen. *Vignea*, sect. *Ovales*. (For its description and illustration see Vánky, 1985:15 and 1987:14 & 17).

Thirumalachar and Pavgi (1953:101) described var. *arthraxonis* of *Melanotaenium brachiariae* Viégas. The study of the type and its comparison with *M. brachiariae* on *Brachiaria* species, revealed essential differences in the form and size of the spores and also the thickness of the spore wall which justify to consider this variety as a distinct species:

Melanotaenium arthraxonis (Thirum. & Pavgi) K. Vánky, **comb.** et **stat. nov.**
Basionym: *Melanotaenium brachiariae* Viegas var. *arthraxonis* Thirumalachar & Pavgi, Sydowia 7:101, 1953. — Type on *Arthraxon* sp., India, Bihar, Parasnath, 14.XII.1952, leg. H. C. Govindu (HCIO 20996!).

Sori in the leaves as ovate or lanceolate, black spots of 3–8 x 5–10 mm. Spores embedded in the leaf tissue, aggregated, variable in shape and size, usually subpolyhedrally irregular, 8–14 x 9.5–19(–24) µm, reddish-brown; wall uneven, 1–4 µm thick, smooth.

The spores of *Melanotaenium brachiariae* Viegas are more regular, smaller, measuring 6.5–11 x 8–13.5 µm, and the spore wall is 1–3 µm thick.

Sporisorium pseudanthistiriae (H. & P. Sydow & Butler) K. Vánky, **comb. nov.** Basionym: *Sorosporium pseudanthistiriae* H. & P. Sydow & Butler, Ann. Mycol. 10:254, 1912. — Type on *Pseudanthistiria hispida* Hook. fil. (Gramineae, subfam. Panicoideae, tribe Andropogoneae, subtribe Anthistiriinae), India, Bombay Presidency, Bassein, 6.IX.1910, R. K. Bhida (HCIO 1604!).

Sori in the spikelets, cylindrical, 1–1.5 x 10–15 mm, first covered by a thick, yellowish-brown fungal peridium which early ruptures from its apex and curls back disclosing the blackish-brown, granular-powdery mass of spore balls and a long, simple, central columella. All spikelets of a raceme or of a group of racemes infected but only a few racemes of an inflorescence affected. Spore balls rather permanent, variable in shape and size, globoid to usually subpolyhedrally irregular, 40–130 x 80–180 µm, dark reddish-brown, opaque, composed of hundreds of spores. Spores subglobose, ovoid to subpolyhedrally irregular, 9–13 x 10–14 µm, outer spores dark reddish-brown, thick-walled (ca. 1 µm), free surface densely, finely echinulate, inner spores light yellowish-brown, thin-walled (ca. 0.5 µm), apparently smooth to very finely punctate. Sterile cells between the spores absent.

Sporisorium pseudanthistiriae differs from all the 19 known smut fungi of the genus *Themeda* related to *Pseudanthistiria* (comp. Vánky, 1994b:153-165), and also from the smut of the closely related *Monocymbium*:

Sporisorium monocymbii (H. Sydow) K. Vánky, **comb. nov.**

Basionym: *Sphacelotheca monocymbii* H. Sydow, Ann. Mycol. 37:200, 1939. — Typus on *Monocymbium ceresiiforme* (Nees) Stapf, Sierra Leone, by the road side 10 miles from Kabala on the road to Musaia, 16.XI.1930, F. C. Deighton (313), BPI 178108, 195108, IMI 43051.

Sori in the spikelets, ovoid-conical, 1–1.5 x 2–4 mm, first covered by a ferrugineous-brown peridium which flakes away disclosing the blackish-brown, semipowdery mass of spores intermixed with sterile cells and a simple, central columella. Sori, which may be partly hidden by the spatheolae, confined to the spikelets, sometimes only to their basal part, sometimes several spikelets may be comprised in one sorus. All spikelets of a raceme infected and usually all racemes of an infected plant affected. Spores single when mature, subglobose, ovoid, ellipsoidal to slightly irregular, 7–9.5 x 8–11(–12) µm, yellowish-brown; wall uniform, ca. 0.8 µm thick, densely and finely punctate-echinulate. Sterile cells larger than the spores (11–18 µm long), hyaline, in irregular groups or chains, collapsed in old specimen; wall 1–1.5 µm thick, smooth.

On Gramineae, subfam. Panicoideae, tribe Andropogoneae, subtribe Anthistiriinae: *Monocymbium ceresiiforme* (Nees) Stapf, C. Africa (Sierra Leone).

SYNONYMS

Tilletia koeleriae and *Ustilago caricis-wallichianae* are *Anthracoidea* species.

The study of the types of *Tilletia koeleriae* Mundkur (1944:52), on supposed *Koeleria cristata* L., and of *Ustilago caricis-wallichianae* Thirumalachar & Pavgi (1953:98), on *Carex wallichiana* Presc., revealed that both are the same *Anthracoidea* species on *Carex setigera* D. Don (subgen. *Carex*, sect. *Trachychlaenae*):

Anthracoidea koeleriae (Mundkur) K. Vánky, **comb. nov.**
Basionym: *Tilletia koeleriae* Mundkur, Indian J. Agric. Sci. 14:52, 1944. — Type on *"Koeleria cristata* L." (= misnamed *Carex setigera* D. Don; rev. I. Kukkonen, H), India, Punjab, Simla, 6200 ft., 21.V.1942, coll. B. P. Pal (HCIO 10001!).

Ustilago caricis-wallichianae Thirumalachar & Pavgi, 1953:98. — Type on *Carex "wallichiana* Presc." (= *Carex setigera* D. Don; rev. I. Kukkonen, H), India, Uttar Pradesh, Ramgarh, VIII.1952, M. J. Thirumalachar (HCIO 20997!).

Sori in some of the ovaries of an inflorescence as subglobose to ellipsoidal, 2–5 mm long, black, hard bodies with powdery surface, when young covered by a thin, silvery membrane which soon flakes away. Spores angular-irregular, elongated, sometimes rounded, 11–21 x 15–26 µm, reddish-brown; wall unevenly thickened, 1–3(–4) µm, protuberances common, light-refractive areas present, internal swellings absent; surface densely, finely verruculose, the spore profile appears nearly smooth to wavy or finely serrate.

A further specimen of "*Tilletia koeleriae* Munkur on *Koeleria cristata* L.", India, Punjab, Dalhousie, 24.VI.1958, G. Lal (HCIO 25954!) represents also *Anthracoidea koeleriae* on *Carex setigera* D. Don (host plant rev. by I. Kukkonen). This specimen possesses slightly darker spores and somewhat coarser warts and less light-refractive areas than the type of this species, but it is identical with the type of *U. caricis-wallichianae* and with a further specimen of "*Cintractia caricis* (Pers.) Magnus" on *Carex setigera* D. Don, India, Simla, Kufri, VI.1945, J. L. Merh (HUV 15400).

According to Kükenthal (1909), beside *Carex setigera* D. Don, also *C. inanis* Kunth, *C. spissa* L., *C. pringlei* L. H. Bailei, *C. hispida* Willd. ex Schkuhr, and *C. glauca* Murr. (*C. flacca* Schreber) belong to sect. *Trachychlaenae*. On these host plants only one *Anthracoidea* species was known: *A. pratensis* (H. Sydow) Boidol & Poelt, lectotype on *Carex flacca*. A comparison of *A. koeleriae* with *A. pratensis* shows that *A. koeleriae* has more irregular, smaller spores than *A. pratensis*, which has spores of 17–27 x 19–30 µm in diameter.

According to Chater (in Tutin & al., 1980:306), *C. flacca* and *C. hispida* belong to another section, sect. *Glaucae*. The occurrence of two different *Anthracoidea* species on these plants seems to support Chater's classification (parasites as host taxonomists!).

Cintractia californica is an *Anthracoidea* species.

Zundel described and distributed *Cintractia californica* Zundel in the exsiccata Mycobiota of North America, Mycobiota of Mount Shasta, No. 64, on "*Juncus Parryi* Engelm.", from USA, California, Mt. Shasta, Mud Creek Canyon, alt. 7000 ft, 8.X.1939 (edited on 30.III.1940). The study of the isotypes in BPI and in HUV (No. 48) revealed that the host plant is a *Carex* species and its smut an *Anthracoidea* species. The heavily infected plants I have seen did not allow the identification of the host species and, consequently, its smut species.

Sorosporium capillipedii is *Macalpinomyces chrysopogonis.*

Ahmad (1956:2) described *Ustilago chrysopogonis* Ahmad, in the culms of *Chrysopogon gryllus* (L.) Trin., Pakistan, Swat State, Kulali-Kalam, 19.VIII.1953, coll. S. Ahmad (no. 4627); isotype in HUV 8999! This name is transferred (opus praesens) into the genus *Macalpinomyces* as *M. chrysopogonis* (Ahmad) K. Vánky.

Mishra (1957:257) described *Sorosporium capillipedii* Mishra, in the culms of *Capillipedium parviflorum* (R. Br.) Stapf, from India, Bihar, Hazaribagh, 10.X.1955, coll. J. N. Mishra (BPI 179479!). A stem smut, collected on *Chrysopogon fulvus* (Spreng.) Chiov. in India, turned out to be identical with *Sorosporium capillipedii*. This name was transferred (Vánky, 1995:228) into the genus *Endosporisorium*. A comparison of the types of *U. chrysopogonis* and *S. capillipedii* revealed that they are conspecific, the first name having priority. The fungus shows characters different from those of a *Ustilago* or of a *Sorosporium* but fits well with the characters of the emended *Macalpinomyces*. (For the description of this fungus see Vánky, 1995:228, under the name of *Endosporisorium capillipedii*).

Thecaphora fimbristylidis is *Tolyposporium mauritianum.*

H. Sydow (1939:201) described *Tolyposporium mauritianum* on *Fimbristylis* sp. from Mauritius. Mundkur & Thirumalachar (1946:4) described *Thecaphora fimbristylidis* on *Fimbristylis monostachyos* (L.) Hassk. (= *F. ovata* (Burm. fil.) Kern) from India (HCIO 10249!). The holotype of *Tolyposporium mauritianum* was lost in Berlin. I propose as lectotype the isotype in HUV (17465). The study of the types of *Tolyposporium mauritianum* and of *Thecaphora fimbristylidis* could not reveal any difference between them but inexactness in the description of the latter species. E. g., in the original description of *Thecaphora fimbristylidis*, the spore balls are described to be composed of 10–14 spores ("cells"). The study of the type specimen revealed (1–)5–16 (or more) spores per ball. The name and the synonym of this smut should be:

Tolyposporium mauritianum H. Sydow, 1939:201.
Lectotype on *Fimbristylis* sp., Mauritius, 1929, coll. E. F. S. Shepherd (selected

here), HUV 17465!

Thecaphora fimbristylidis Mundkur & Thirumalachar, 1946:4, on *Fimbristylis monostachyos* Hassk. (= *F. ovata* (Burm. fil.) Kern), India, Mysore, Wagamangla, Bettahalli, 20.VI.1943, M. J. Thirumalachar (HCIO 10249!).

Sori on the inner floral organs forming black, granular powdery masses of spore balls, completely hidden by the floral envelopes. Spore balls subglobose, ovoid, somewhat irregular, rarely elongated, 16–36 x (16–)20–40 µm, dark reddish-brown, composed of (1–)5–16 (or more) firmly united spores. Spores subglobose, hemiglobose, subcuneiform or somewhat irregular, with flattened contact sides, 9–15 x 12–16(–20) µm; wall 1–2.5 µm thick, free surface densely, roughly verrucose.

On Cyperaceae: *Fimbristylis ovata* (Burm. fil.) Kern (*Abildgaardia ovata* (Burm. fil.) Kral, *Fimbristylis monostachyos* Hassk.), *Fimbristylis* sp., South Africa, Mascarene Islands (Mauritius, Reunion), South Asia (India).

***Sorosporium baluchistani* is *Sporisorium andropogonis*.**

Sorosporium baluchistani Ahmad, 1956:10, (type on *Bothriochloa* sp., West Pakistan, Baluchistan, Hindubag, 7.VI.1951, I. Ilahi; isotype in HUV 17366) was compared with *Sporisorium andropogonis* (Opiz) K. Vánky (type on *Andropogon ischaemum* L., *Bothriochloa ischaemum* (L.) Keng, = *Dichanthium ischaemum* (L.) Roberty). No difference could be found in sorus structure, spore- and sterile cell morphology between the type of *Sorosporium baluchistani* and *Sporisorium andropogonis* on host plants belonging to the genera *Andropogon, Bothriochloa, Dichanthium* and *Heteropogon.* Consequently, *Sorosporium baluchistani* Ahmad is considered to be a synonym of *Sporisorium andropogonis* (Opiz) K. Vánky. (For description and illustration of this species see Vánky, 1994a:198 & 209).

ACKNOWLEDGEMENTS

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LITERATURE CITED

Ahmad, S. 1956. Ustilaginales of West Pakistan. – Mycol. Pap. 64:1-17.

Chater, A. O. 1980. Carex. In Tutin & al. (eds.) Flora europaea 5:290-323. – Cambridge University Press.

Clayton, W. D. & Renvoize, S. A. 1986. Genera graminum. Grasses of the world. – London, 389 pp.

Fischer, G. W. 1952. Some new species of Ustilaginales from North America. – Res. Stud. State Coll. Wash. 20:3-10.

Gandhe, R. V. 1978. Smuts of Maharashtra. Doctoral thesis. – University of Poona, 270 pp. (typewritten).

Karatygin, I. V. & Azbukina, Z. M. 1989. Definitorium fungorum URSS. Ordo Ustilaginales, Fasc. I. Familia Ustilaginaceae (in Russian). – Nauka, Leningrad, 220 pp.

Kükenthal, G. 1909. Cyperaceae – Caricoideae. In Engler, A., Das Pflanzenreich, etc. IV. 20. – Leipzig, 824 pp.

Langdon, R. F. N. & Fullerton, R. A. 1975. Sorus ontogeny and sporogenesis in some smut fungi. – Austral. J. Bot. 23:915-930.

--- & --- 1977. *Macalpinomyces*, a new genus of smut fungi. – Trans. Brit. Mycol. Soc. 68:27-30.

Lavrov, N. N. 1934. Ustilagineae novae vel rarae Asiae septentrionalis (in Russian). – Trudy Tomsk. Gosud. Univ. 86:83-87.

Ling, L. 1949. Taxonomic notes on Asiatic smuts. I. – Sydowia 3:123-134.

--- 1953. Taxonomic notes on the Ustilaginales. III. – Sydowia 7:151-157.

Liro, J. I. 1935. Über neue, seltene und vermeinte Ustilagineen. – Ann. Bot. Soc. Zool.-Bot. Fenn. "Vanamo" 6:1-18.

Massee, G. E. 1911. Fungi exotici. XII. – Bull. Misc. Inform. 1911:223-226 + figs. 15-17.

Mishra, J. N. 1957. Ustilaginales of Bihar. III. Some new or interesting smuts. – Mycologia 49:256-261.

Mundkur, B. B. 1944. Some rare and new smuts from India. – Indian J. Agric. Sci. 14:49-52.

--- & Thirumalachar, M. J. 1946. Revisions of and additions to Indian fungi. I. – Mycol. Pap. 16:1-27.

Patil, M. S. 1992. Smuts of Maharashtra. – Indian Phytopathol. 45:179-184.

Patouillard, N. 1906. Champignons Algéro-Tunisiens nouveaux ou peu connus. – Bull. Soc. Mycol. France 22:195-200.

Sydow, H. 1935. Beschreibungen neuer südafrikanischer Pilze. VI. – Ann. Mycol. 33:230-237.

--- 1939. Novae fungorum species XXVII. – Ann. Mycol. 37:197-253.

--- & Sydow, P. 1916. Fungi amazonici a cl. E. Ule lecti. – Ann. Mycol. 14:65-97.

--- & --- & Butler, E. J. 1906. Fungi Indiae orientalis. Pars I. – Ann. Mycol. 4:424-445.

--- & --- & --- 1907. Fungi Indiae orientalis. Pars II. – Ann. Mycol. 5:485-515.

--- & --- & --- 1912. Fungi Indiae orientalis. Pars IV. – Ann. Mycol. 10:243-280.

Thirumalachar, M. J. & Pavgi, M. S. 1953. Notes on some Indian Ustilagineae. VII. – Sydowia 7:98-102.
Vánky, K. 1985. Carpathian Ustilaginales. – Symb. Bot. Upsal. 24(2):1-309.
--- 1987. Illustrated genera of smut fungi. – Cryptogamic Studies 1:1-159 (ed. W. Jülich). Gustav Fischer Verlag. Stuttgart/New York.
--- 1992. Taxonomical studies on Ustilaginales. IX. – Mycotaxon 43:417-425.
--- 1994a. European smut fungi. – Gustav Fischer Verlag, Stuttgart, Jena, New York, 570 pp.
--- 1994b. Taxonomical studies on Ustilaginales. XI. – Mycotaxon 51:153-174.
--- 1995. Taxonomical studies on Ustilaginales. XII. – Mycotaxon 54:215-238.
--- 1996. The genus *Macalpinomyces* (Ustilaginales). – Mycotaxon 59:115-126.
Viennot-Bourgin G. – 1951a. Ustilaginales d'Afrique (Première note). – Rev. Mycol. Suppl. Colon. 16:101-106.
--- 1951b. Étude morphologique de quelques lésions charbonneuses des végétaux. – Ann. Épiphyt. 2:456-478.
Wang, Y. C. 1962. Some new species and a new combination of smut fungi (in Chinese). – Acta Botanica Sinica 10:133-136.
Zundel, G. L. 1953. The Ustilaginales of the World. – Pennsylvania State Coll. School Agric. Dept. Bot. Contrib. 176:XI + 1-410.

CORRIGENDA

Vánky (1992:419) described a new *Entorrhiza* species naming it, in the honour of the late Dr. Judith E. Fineran, *Entorrhiza "finerani"*. The original spelling of the specific epithet is gramatically incorrect. According to the ICBN, Art. 73.1, 73.10 and Recommendation 73 C 1 (b), it should be *E. fineraniae.*

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NEW USTILAGINALES FROM AUSTRALIA.*

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ABSTRACT

Studying the smut fungi (Ustilaginales) of *Gahnia, Fimbristylis, Gymnoschoenus* and *Tetraria* (Cyperaceae), those of the subtribe *Triodiinae* (Gramineae), as well as the *Entyloma* of *Bracteantha* (Compositae), the following new species were found, mostly from Australia: *Tolyposporium gahniae* K. & C. Vánky (type on *Gahnia radula*), *Tolyposporium triste* K. Vánky (type on *Gahnia tristis*, China), *Cintractia mitchellii* K. Vánky (type on *Fimbristylis schultzii*), *Tolyposporium gymnoschoeni* K. & C. Vánky (type on *Gymnoschoenus sphaerocephalus* and *G. anceps*), *Tolyposporium tetrariae* K. Vánky (type on *Tetraria capillaris*), *Ustilago triodiae* K. Vánky (type on *Triodia microstachya* and *Plectrachne pungens*), and *Entyloma bracteanthae* K. Vánky (type on *Bracteantha acuminata*).

Farysia endotricha (Berk.) H. & P. Sydow is reported for the first time from Australia.

Neotype is designated for *Ustilago altilis*.

THE SMUT FUNGI OF *GAHNIA* (CYPERACEAE).

Identifying some recently collected Ustilaginales, I revised the smut fungi of *Gahnia.* This genus, with its ca. 40 species, is centred in Australasia extending to Asia and the Pacific Islands. On species of *Gahnia* two smut fungi have been reported: *Farysia endotricha* (Berkeley) H. & P. Sydow, and *Tolyposporium muellerianum* (Thümen) McAlpine. Two further *Tolyposporium* species are described in this paper.

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* Part 134 in the series "Studies in Heterobasidiomycetes" from the Botanical Institute, University of Tübingen.

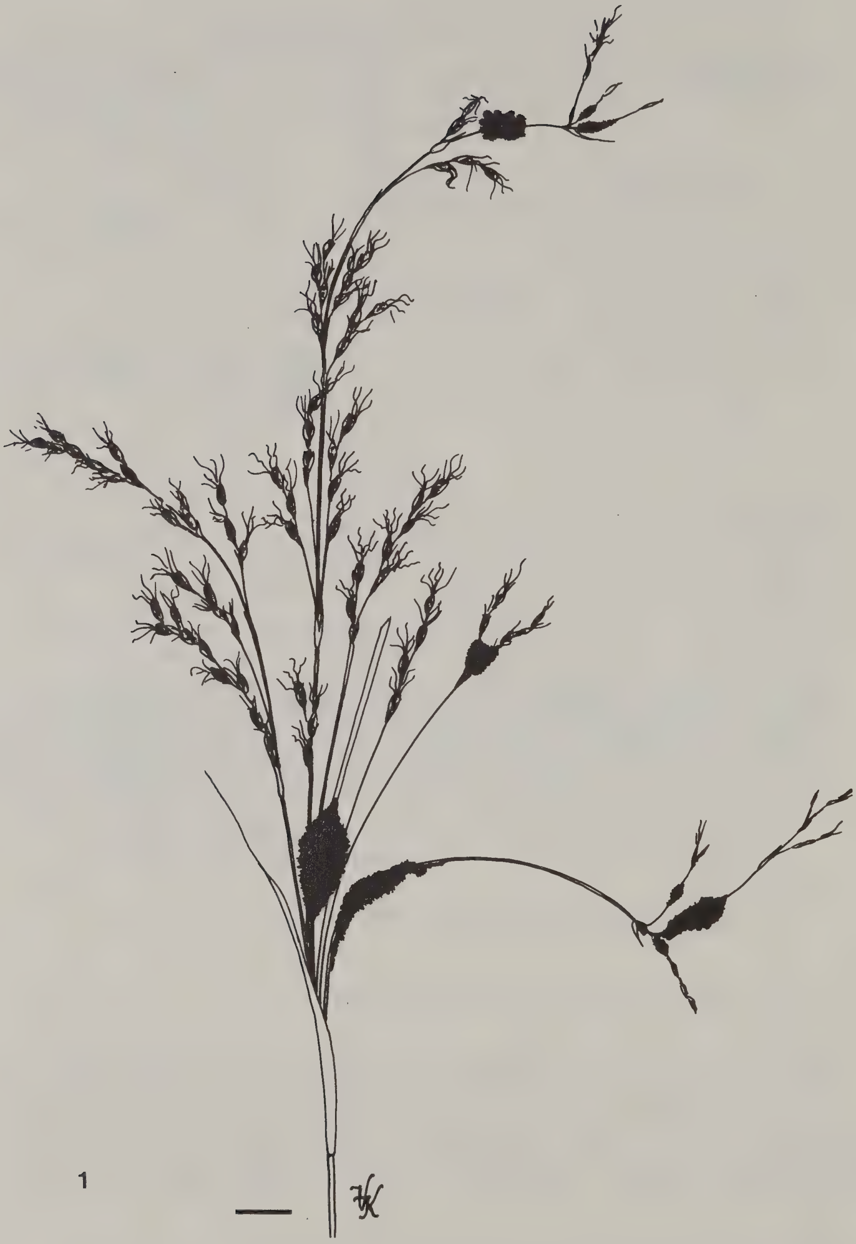

Fig. 1. Sori of *Farysia endotricha* (Berk.) H. & P. Sydow on *Gahnia setifolia* (A. Rich.) Hooker fil., New Zealand. Vánky, Ust. exs. No. 568 (HUV 12666). Bar = 1 cm.

Farysia endotricha (Berkeley) H. & P. Sydow, 1919:41.
Ustilago endotricha Berkeley, in Hooker, 1855:196. — *Elateromyces endotrichus* (Berkeley) Cunningham, 1924:416. — Type on *Gahnia* sp., New Zealand, Auckland, coll. Sinclair (K).

Sori (Fig. 1) surrounding the pedicels and main axes of the inflorescence (only rarely in the flowers), fusiform, ellipsoidal or globoid, 0.3–1(–2) x 0.5–4(–7) cm, black, composed of compact spore masses with powdery surface traversed by numerous fascicles of sterile hyphae extending beyond the spore masses. Spores when young in irregular groups, later singly, globose, subglobose, ellipsoidal or irregular, pyriform, (11–)12–17 x 13–19 µm, olivaceous-brown; wall 2–3 µm thick including the typically cracked (scaly) exospore. Spore formation at the basal part of the sori in radially arranged sporogenous hyphae. The young spores are catenulate, fusiform, yellow, thick-walled, smooth. With maturation the spores become larger, ellipsoidal or globose, pigmented, with cracked exospore. Spore germination (Fig. 2; freshly collected spores, in water, at room temp., after 5 days.) resulted in septate basidia or in long filaments. The basidia give rise to hyphae or to shorter or longer, fusiform basidiospores which separate easily.

On *Gahnia* species, Australasia: *G. grandis* (Labill.) S. T. Blake (Australia, Tasmania, S. of Dover, Hasting Caves, 16.I.1980, C. Palzer; HO), *G. pauciflora* T. Kirk (NZ), *G. procera* J. R. & G. Forst. (NZ), and *G. setifolia* (A. Rich.) Hooker fil. (NZ).

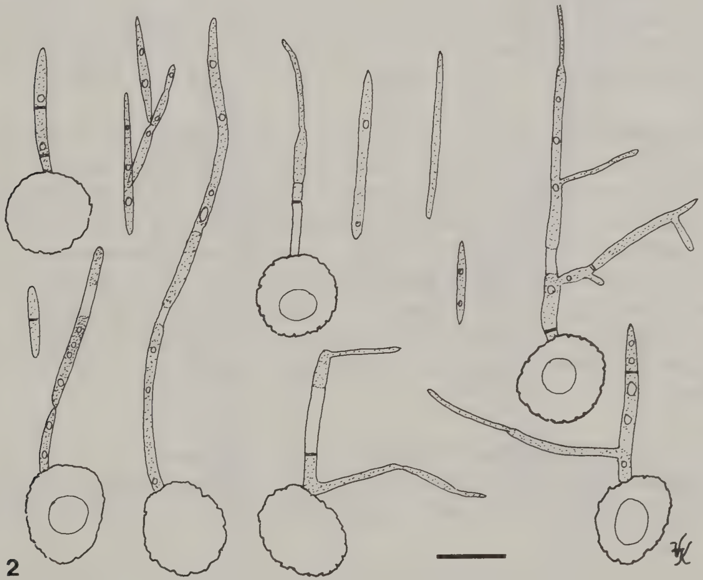

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Fig. 2. Spore germination of *Farysia endotricha* (Berk.) H. & P. Sydow on *Gahnia setifolia* (A. Rich.) Hooker fil. (in water, at room temp., after 5 days) New Zealand, 7.II.1990 (HUV 14950). Bar = 10 µm

Tolyposporium muellerianum (Thümen) McAlpine, 1910:189.

Sorosporium muellerianum Thümen, 1878:444. — *Thecaphora muelleriana* (Thümen) Thirumalachar & Neergaard, 1977(1978):187 (as "*muellerianum*"). — Type on *Cladium filum* (Labill.) R. Br. (= *Gahnia trifida* Labill., teste K. Vánky), Australia, Victoria, Western Point, coll. F. von Müller (HUV 5481!). Topotype in Vánky, Ust. exs. No. 986.

Sori (Fig. 3) in the spikelets, hidden by the elongated and deformed floral envelopes. The aborted spikelets are filled with a black, first agglutinated later granular-powdery mass of spore balls. Infection systemic; all spikelets of an inflorescence are affected. Spore balls (Figs. 4, 5) subglobose, ovoid, ellipsoidal, oblong or slightly irregular, (30–)35–65(–80) x (30–)40–100 µm, dark reddish- to blackish-brown or opaque, composed of numerous, firmly united spores. Spores (Fig. 4) subcuneiform or subpolyhedrally irregular with flattened contact sides, on the free surface measuring 7–13 x 10–16(–18) µm, radially (8–)10–16(–18) µm long, dark reddish- or blackish-brown; wall of the free surface 2–4 µm thick, including the irregular, confluent low warts, that of the contact sides thin (0.5–1 µm), smooth.

On *Gahnia trifida* Labill. (Australia, Victoria).

Tolyposporium gahniae K. & C. Vánky, **sp. nov.**

Typus in matrice *Gahnia radula* (R. Br.) Benth. (det. D. I. Morris, HO), Australia, Tasmania, 3 km S. Gladstone, inter oppid. Bridport et St. Helens, 41°00' S, 148°00' E, alt. cca. 100 m, 15.III.1996, leg. C. & K. Vánky. Holotypus in HO, isotypi in Herbario Ustil. Vánky (HUV 17625), BPI et in Vánky, Ust. exs. No. 981.

Tolyposporium gahniae (Fig. 10) a specie *Tolyposporium muellerianum* (Thümen) McAlpine (basionymum: *Sorosporium muellerianum* Thümen, Flora 61:444, 1878) imprimis glomerulis sporarum laxis (Figg. 6, 7) e sporis rotundatis (Figg. 6, 7), pariete superficiei liberae earum tantum 1–1,5 µm crasso distinctum.

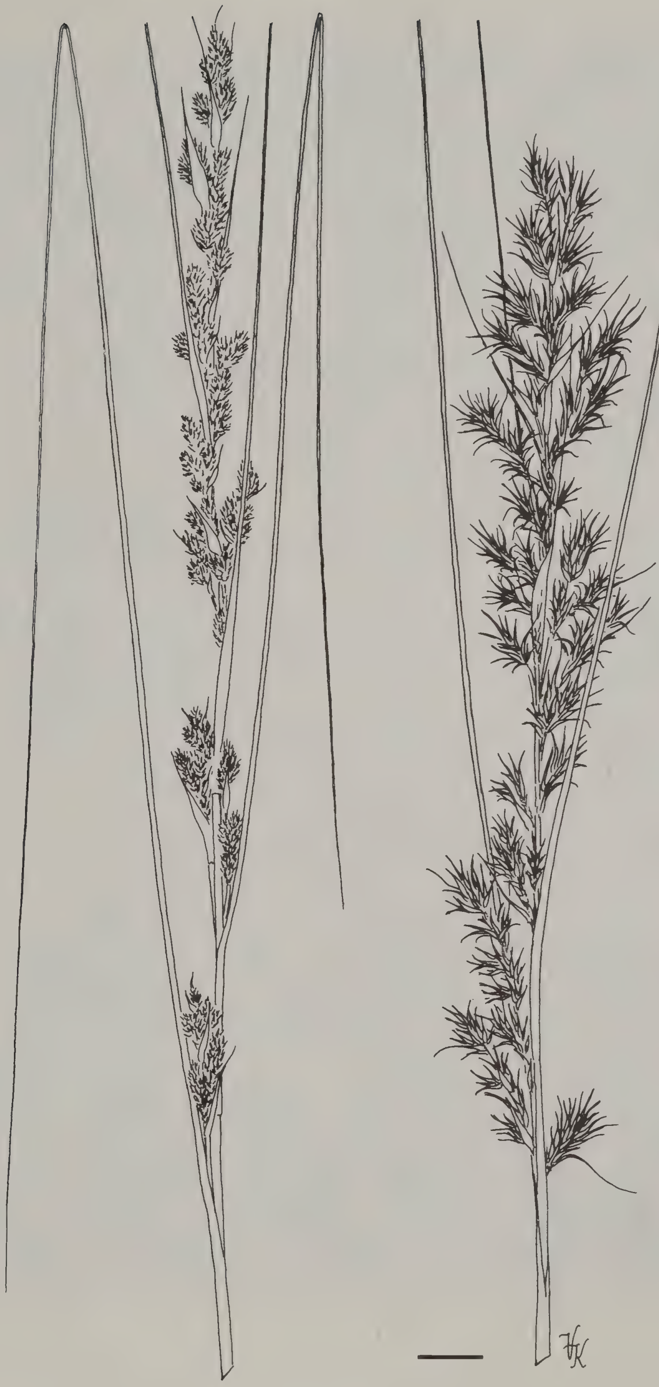
Tolyposporium gahniae (Fig. 10) differs from *Tolyposporium muellerianum* (Thümen) McAlpine especially in having loose spore balls (Figs. 6, 7) composed of rounded spores (Figs. 6, 7) with only 1–1.5 µm thick wall of the free surface.

The spore balls in *T. muellerianum* are compact, composed of firmly united, subcuneiform or subpolyhedrally irregular spores with 2–4 µm thick wall of the free surface.

Tolyposporium triste K. Vánky, **sp. nov.**

Typus in matrice *Gahnia tristis* Nees, China, Fuijan (Fukien), Nanping, 26°40' N, 118°07' E, 8.VI.1955, leg. Han Shu-jin (HUV 17551 ex HMAS 71628).

Fig. 3. Sori of *Tolyposporium muellerianum* (Thümen) McAlpine on *Gahnia trifida* Labill., Australia (HUV 17621). A healthy (left) and a diseased plant (right). Bar = 2 cm.



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Paratypus in matrice *Gahnia tristis* Nees, Hong Kong, Aberdeen, 22°13' N, 114°09' E, 8.II.1962, leg. Chan Shu Tong (IMI 99147).

Sori in spiculis, involucris floralibus perfecte cooperti. Spiculi massa glomerulorum sporarum nigra, granuloso-pulverea completi. Infectio systemica, spiculae omnes eiusdem inflorescentiae infecti. Glomeruli sporarum (Figg. 8, 9) globosi, subglobosi usque ellipsoidales, 15–40 x (15–)20–50 µm, atro-rufobrunnei usque opaci, e sporis (3–)5 usque compluribus, firmiter unitis compositi. Sporae (Figg. 8, 9) globosae, subglobosae, ellipsoidales, subcuneiformes vel irregulares cum lateribus contingentibus deplanatis, 10–16(–18) µm longae, atro-rufobrunneae; pariete superficiei liberae 1–2(–2,5) µm crasso, subtiliter, dense, irregulariter plane verrucoso, pariete laterum contingentium tenui (cca. 1 µm), levi.

Sori in the spikelets, completely hidden by the floral envelopes. The spikelets are filled with the black, granular-powdery mass of spore balls. Infection systemic; all spikelets of an inflorescence are affected. Spore balls (Figs. 8, 9) globose, subglobose to ellipsoidal, 15–40 x (15–)20–50 µm, dark reddish-brown to opaque, composed of (3–)5 to numerous, firmly united spores. Spores (Figs. 8, 9) globose, subglobose, ellipsoidal, subcuneiform or irregular with flattened contact sides, 10–16(–18) µm long, dark reddish-brown; wall of the free surface 1–2(–2.5) µm thick, finely, densely, irregularly flat verrucose, wall of the contact sides thin (ca. 1 µm), smooth.

On *Gahnia tristis* Nees (E. Asia: China, Hong Kong).

Tolyposporium triste differs from *T. muellerianum* and *T. gahniae* especially in having much smaller spore balls containing less spores.

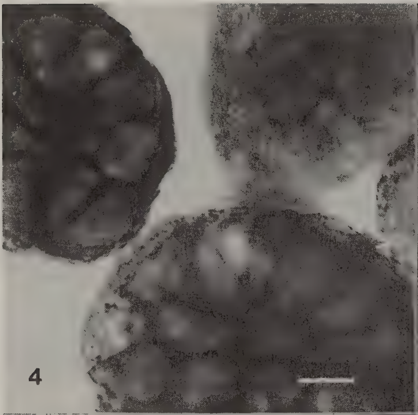
Key to the smut fungi of *Gahnia*.

1. Sori surrounding the floral stems or pedicels, traversed by fascicles of sterile hyphae...*Farysia endotricha*
– Sori in the spikelets, not traversed by fascicles of sterile hyphae 2
2. Spore balls 15–50 µm long, composed of 3 to many spores .... *Tolyposporium triste*
– Spore balls 30–100 µm long, composed of dozens of spores..........................3
3. Spores tightly agglomerated, subcuneiform or subpolyhedrally irregular. Spore wall of the free surface 2–4 µm thick.........*Tolyposporium muellerianum*
– Spores loosely agglomerated, rounded. Spore wall of the free surface 1–1.5 µm thick ....*Tolyposporium gahniae*

Figs. 4, 5. Spore balls and spores of *Tolyposporium muellerianum* (Thümen) McAlpine on *Gahnia trifida* Labill. in LM and in SEM (type).

Figs. 6, 7. Spore balls and spores of *Tolyposporium gahniae* K. & C. Vánky on *Gahnia radula* (R. Br.) Benth. in LM and in SEM (type).

Figs. 8, 9. Spore balls and spores of *Tolyposporium triste* K. Vánky on *Gahnia tristis* Nees in LM and in SEM (type). Bars = 10 µm.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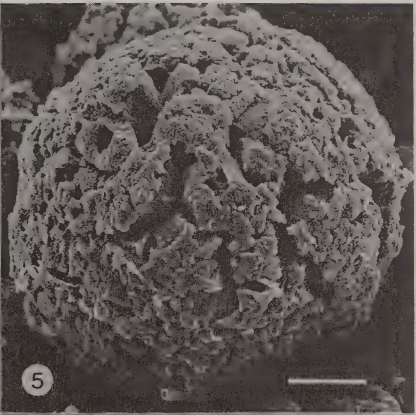
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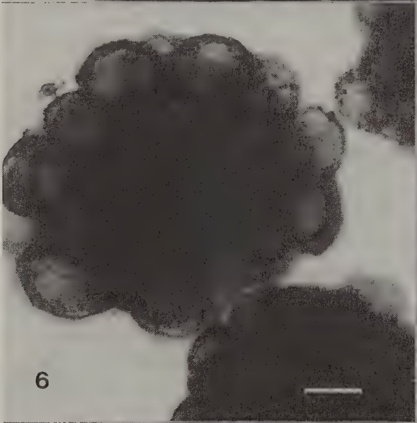
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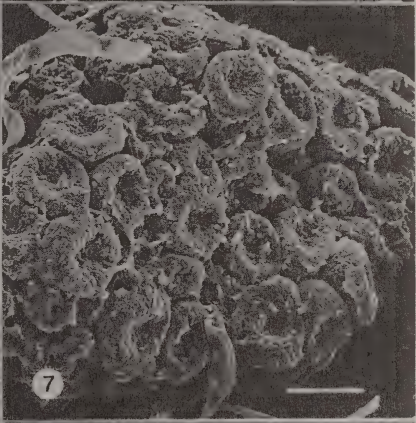
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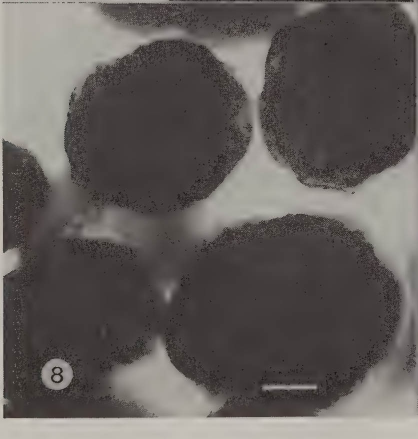
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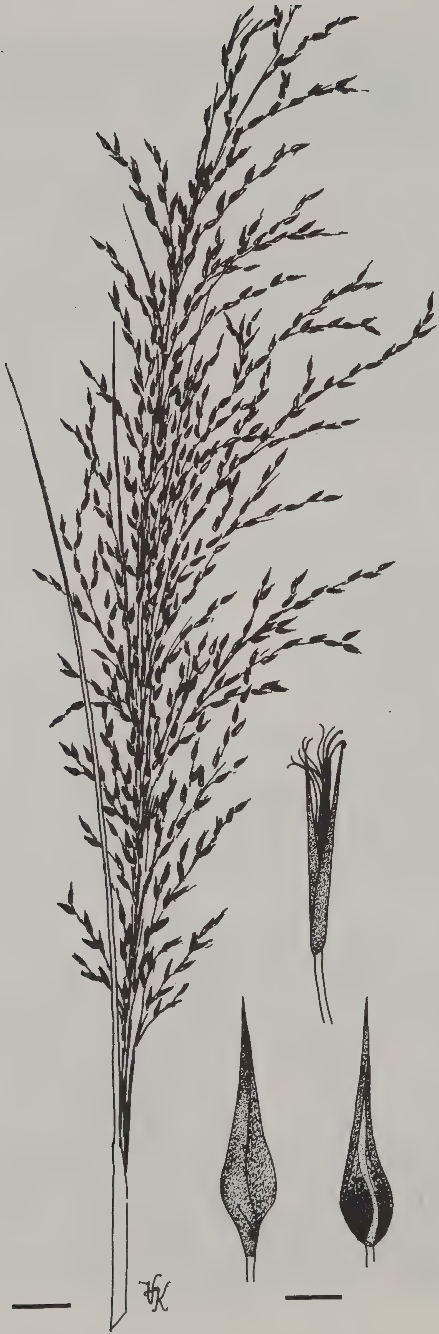

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THE SMUT FUNGI OF *FIMBRISTYLIS* (CYPERACEAE).

Based on the studies of Ling (1948, 1950), Langdon (1977), and Vánky (in print), of the smut fungi described on *Fimbristylis,* the following five species could be recognised: 1. ***Cintractia axicola*** (Berk.) Cornu (with its synonyms *Ustilago axicola* Berk., *Ustilago fimbristylidis* Thümen, *Cintractia suedae* Sawada ex Ito, *C. fimbristylis-kagiensis* Sawada, and its var. *fukiensis* Y. Ling & Yen, *C. peribebuyensis* (Speg.) Speg., and *C. mundkuri* Chowdury), 2. ***Cintractia fimbristylicola*** Pavgi & Mundkur, 3. ***Cintractia fimbristylis-miliaceae*** (Hennings) Ito (syn. *Ustilago fimbristylis-miliaceae* P. Henn., *C. clintonii* Cif., *C. pulchra* Ito), 4. ***Dermatosorus fimbristylidis*** (Thirumalachar & Narasimhan) Langdon (syn. *Zundelula fimbristylidis* Thirum. & Naras.), and 5. ***Tolyposporium mauritianum*** H. Sydow (syn. *Thecaphora mauritiana* (H. Sydow) L. Ling, *Thecaphora fimbristylidis* Mundkur & Thirumalachar).

A smut fungus collected on *Fimbristylis schultzii* in Australia turned out to be different from all these species. It is described as:

Cintractia mitchellii K. Vánky, **sp. nov.**

Typus in matrice *Fimbristylis schultzii* Boeckler (det. K. L. Wilson, NSW), Australia, Western Australia, Kimberley region, pr. Kalumburu, 14°18' S, 126°39' E, alt. cca. 30 m, 21.II.1996, leg. A. A. Mitchell, C. Brockway, C. & K. Vánky. Holotypus in PERTH, isotypi in Herbario Ustil. Vánky (HUV 17666) et in Vánky, Ust. exs. (inedited).

Sori (Fig. 11) evolutionem a parte basali spiculae serius totaliter destructae inchoantes, primo peridio albicanti, origine fungali et residuis telarum matricalium cooperti. Peridio brevi rupto, resoluto, massae sporarum nigrae, agglutinatae, globosae usque ovoideae, superficie pulvereae, diametro 1–2 x 1–3 mm patefactae. Spiculae paucae tantum inflorescentiae eiusdem affectae. Sporae (Figg. 13, 14) parum deplanatae, visu plano subcirculares, late ellipticae usque parum irregulares, 9,5–13,5 x (10–)11–14,5 μm, visu laterali 6,5–9 μm crassae, mediocriter rufulobrunneae; pariete aequali, cca. 1 μm crasso, valde subtiliter et dense, lineam extremam sporae non afficienter, punctato-verruculosae, in SEM subtiliter, irregulariter verrucoso-reticulatae. Germinatio sporarum (Fig. 19; in MYP, temperatura conclavis, in 1 die) basidiis 4-cellularibus, 4–5,5 x 25–32 (–36) μm. Cellulae basidiales bini copulatae basidiosporas ovoideo-elongatas vel subcylindricas, 3–4 x 20–30(–40) μm, vel hyphas longas, 1,5–2 μm crassas producentes.

Sori (Fig. 11) comprise the spikelets, starting to develop from their basal part, first covered by a whitish peridium of fungal origin and also remnants of host tissues. The peridium ruptures early, flakes away disclosing the black,

Fig. 10. Sori of *Tolyposporium gahniae* K. & C. Vánky on *Gahnia radula* (R. Br.) Benth. (type). Enlarged a healthy and two infected spikelets, with glumes partly removed. Bars = 1 cm and 2 mm, respectively.

agglutinated, globose to ovoid spore masses with powdery surface, 1–2 x 1–3 mm in diameter. Only a few spikelets of an inflorescence are affected. Spores (Figs. 13, 14) slightly flattened, in plane view subcircular, broadly elliptic to slightly irregular, 9.5–13.5 x (10–)11–14.5 µm, in side view 6.5–9 µm thick, medium reddish-brown; wall uniform, ca. 1 µm wide, in LM very finely and densely punctate-verruculose which does not affect the spore profile, in SEM finely, irregularly verrucose-reticulate. Spore germination (Fig. 19; on MYP, at room temp., after one day) results in 4-celled basidia measuring 4–5.5 x 25–32 (–36) µm. Basidial cells copulate in pairs giving rise to ovoid-elongated or subcylindrical basidiospores of 3–4 x 20–30(–40) µm, or to long, 1.5–2 µm wide hyphae.

This fungus is named after its discoverer, Andrew A. Mitchell (Perth, Western Australia), who also collected many other, interesting, rare and undescribed smut fungi.

Key to the smut fungi of *Fimbristylis*.

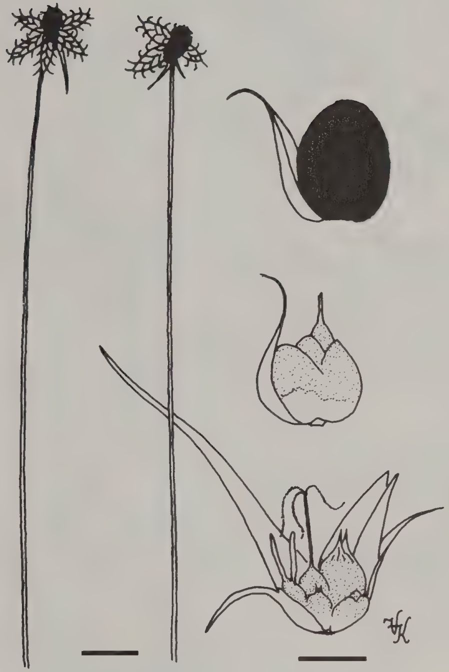
1. Spores in balls 2
– Spores single 3
2. Spore balls composed of spores only .... *Tolyposporium mauritianum*
– Spore balls composed of spores dispersed in a parenchymatous fungal tissue,
  surrounded by a cortex of sterile cells.................. *Dermatosorus fimbristylidis*
3. Spores apparently smooth to finely punctate- or verruculose-reticulate............ 4
– Spores evidently verrucose- or echinulate-reticulate 5
4. Spores 10–14.5 µm long. Sori in the spikelets.................. *Cintractia mitchellii*
– Spores 12–17 µm long. Sori around the base of primary or
  auxiliary rays, or in the spikelets .... *Cintractia axicola*
5. Spores 8–12 µm long, verrucose-reticulate ....*C. fimbristylicola*
– Spores 9.5–14.5 µm long, echinulate-reticulate .... *C. fimbristylis-miliaceae*

A NEW SMUT FUNGUS ON *TETRARIA* (CYPERACEAE).

Tetraria is a genus of about 40 species, mainly South African, with a few species extending to Australia. No smut fungus was reported on *Tetraria*. Recently, smutted *Tetraria capillaris* (F. Mueller) J. M. Black was collected in Western Australia. The same fungus was also found between unidentified fungi in the mycological herbarium in Hobart, collected in Tasmania.

Tolyposporium tetrariae K. Vánky, **sp. nov.**

Typus in matrice *Tetraria capillaris* (F. Mueller) J. M. Black (det. K. L. Wilson, NSW), Australia, Western Australia, 75 km S.S.E. urbe Perth, via Albany Hwy, 32°29' S, 116°21' E, alt ca. 400 m, 9.II.1966, leg. C. & K. Vánky. Holotypus in PERTH, isotypus in Herbario Ustil. Vánky (HUV 17745), et in Vánky, Ust. exs. No. 991. Paratypus in matrice *Tetraria capillaris*, Australia, Tasmania, Murdunna, 42°57' S, 147°52' E, 6.II.1971, N. Beadle & W. M. Curtis (HO 123064).



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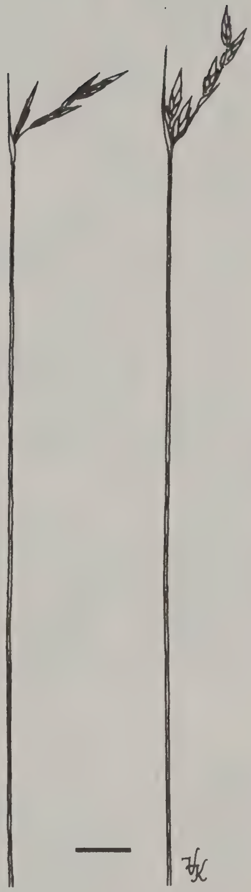

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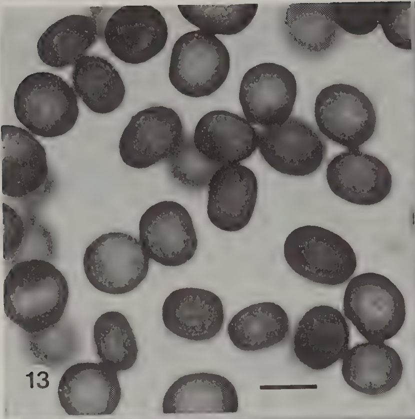
Fig. 11. Sori of *Cintractia mitchellii* K. Vánky on *Fimbristylis schultzii* Boeckler (type). Enlarged three sori in different developmental stages. Bars = 1 cm and 2 mm, respectively.

Fig. 12. Sori of *Tolyposporium tetrariae* K. Vánky on *Tetraria capillaris* (F. Mueller) J. M. Black (type) and a healthy plant (left). Bar = 1 cm.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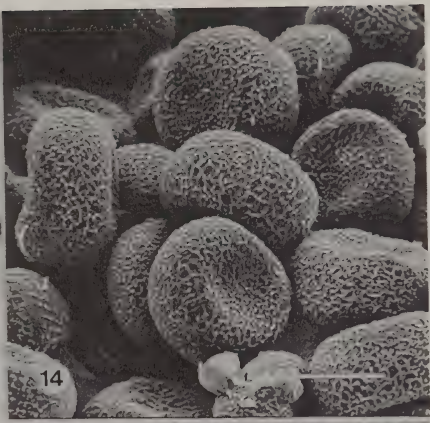
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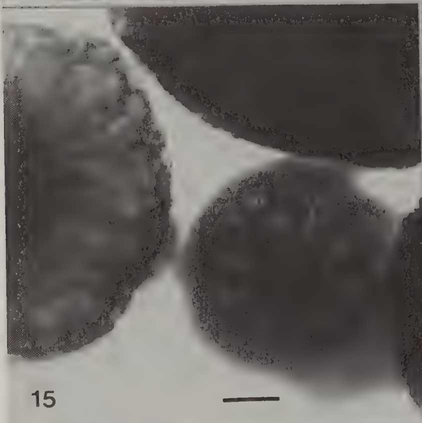
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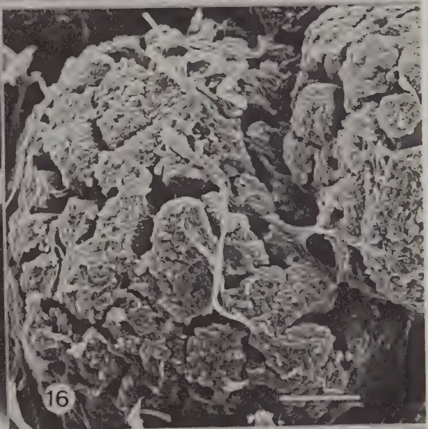
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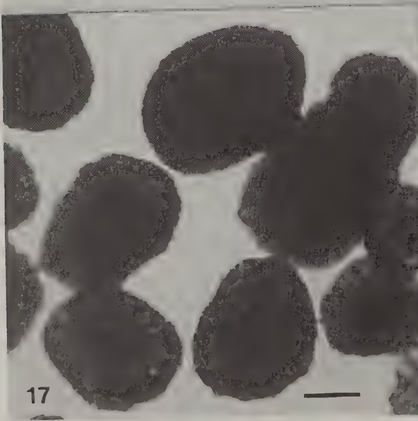
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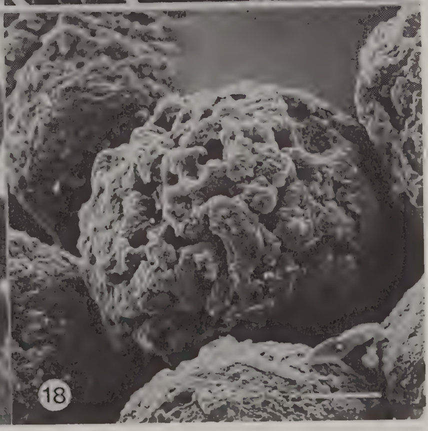
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Sori (Fig. 12) in spiculis, tumefacti, massa nigra, granuloso-pulverea glomerulorum sporarum completi, involucris floralibus perfecte cooperti. Glomeruli sporarum (Figg. 15, 16) subglobosi, ellipsoidales, elongati vel irregulares, 30–65(–80) x 35–90(–105) µm, atro-rufobrunnei, e multitudine sporarum firmiter unitarum compositi. Sporae (Fig. 15) subcuneiformes usque subpolyedrice irregulares, visu superficiali polyangulares, 7–13 x 9–15(–20) µm, visu mediano opticali 10–20 µm longae, rufobrunneae; pariete laterum contingentium tenui (0,5–0,8 µm), levi, illo superficiei liberae 1,5–3 µm crasso, simul cum verrucis humilibus irregularibus.

Sori (Fig. 12) in the swollen spikelets, filled with a black, granular-powdery mass of spore balls, completely hidden by the floral envelopes. Spore balls (Figs. 15, 16) subglobose, ellipsoidal, elongated or irregular, 30–65(–80) x 35–90 (–105) µm, dark reddish-brown, composed of a great number of firmly united spores. Spores (Fig. 15) subcuneiform to subpolyhedrally irregular, in surface view polyangular, 7–13 x 9–15(–20) µm, in optical median view 10–20 µm long, reddish-brown; wall of the contact sides thin (0.5–0.8 µm), smooth, that of the free surface 1.5–3 µm thick, including the low, irregular warts.

A SMUT FUNGUS ON *GYMNOSCHOENUS* (CYPERACEAE).

Gymnoschoenus Nees is a small genus of two species, endemic to Australia. No smut fungus was yet reported on *Gymnoschoenus*. Recently, both *G. sphaerocephalus* (R. Br.) Hooker fil., and *G. anceps* (R. Br.) C. B. Clarke were collected infected by the same smut fungus:

Tolyposporium gymnoschoeni K. & C. Vánky, **sp. nov.**

Typus in matrice *Gymnoschoenus sphaerocephalus* (R. Br.) Hooker fil., Australia, Tasmania, East Coast, 22 km S.W. Dower, via No. 636, pr. Lune River, 43°26' S, 146°54' E, alt. cca. 10 m, 19.III.1996, leg. C. & K. Vánky. Holotypus in HO, isotypi in HUV (17627), BPI et in Vánky, Ust. exs. (ineditus). Paratypi in matrice *Gymnoschoenus anceps* (R. Br.) C. B. Clarke, Australia, Western Australia, Manjimup Distr., 140 km W. Albany, 22 km N.W. Walpole, pr. Inlet River, 34°55' S, 116°41' E, alt. ca. 40 m, 13.II.1996, leg. C. & K. Vánky, in PERTH, isoparatypus in HUV (17664); et in matrice *G. sphaerocephalus*, Tasmania, West Coast, cca. 18 km S.S.E. urbe Queenstown, ad lacum Burbury, 42°12' S, 145°37' E, alt. cca. 240 m, 12.III.1996, leg. C. & K. Vánky (HO, HUV 17777)

Figs. 13, 14. Spores of *Cintractia mitchellii* K. Vánky on *Fimbristylis schultzii* Boeckler in LM and in SEM (type).

Figs. 15, 16. Spore balls and spores of *Tolyposporium tetrariae* K. Vánky on *Tetraria capillaris* (F. Mueller) J. M. Black in LM and in SEM (type).

Figs. 17, 18. Spore balls and spores of *Tolyposporium gymnoschoeni* K. & C. Vánky on *Gymnoschoenus sphaerocephalus* (R. Br.) Hooker fil. in LM and in SEM (type). Bars = 10 µm.

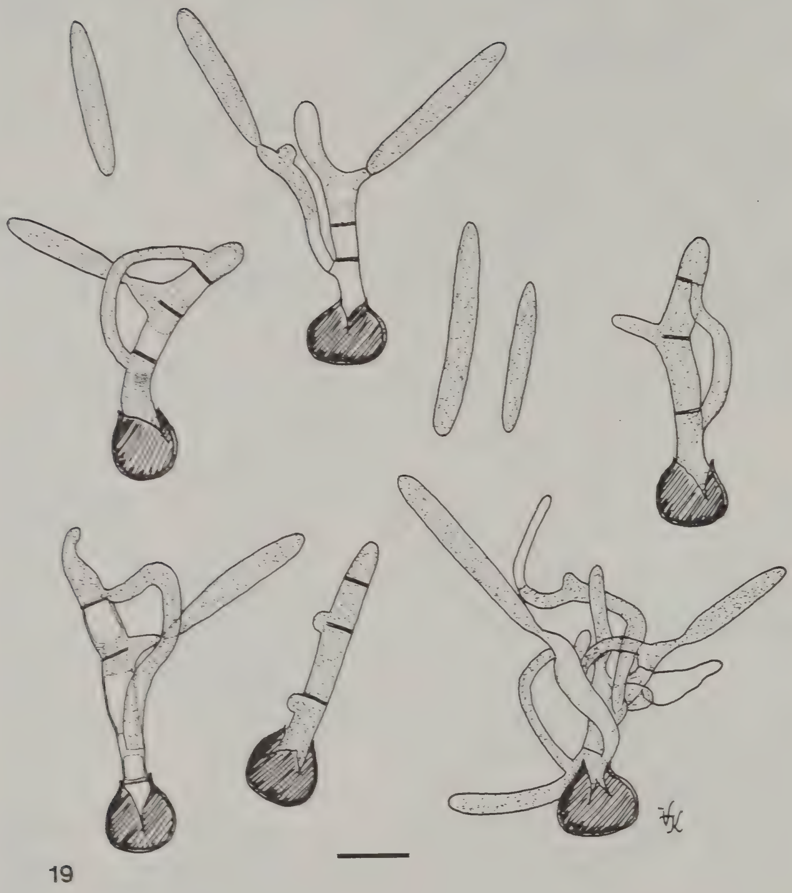

Fig. 19. Spore germination of *Cintractia mitchellii* K. Vánky, showing 4-celled basidia of different developmental stages, some of them with copulation bridge and also producing ellipsoidal, elongated basidiospores (type; on MYP, at room temp., after one day). Bar = 10 µm.

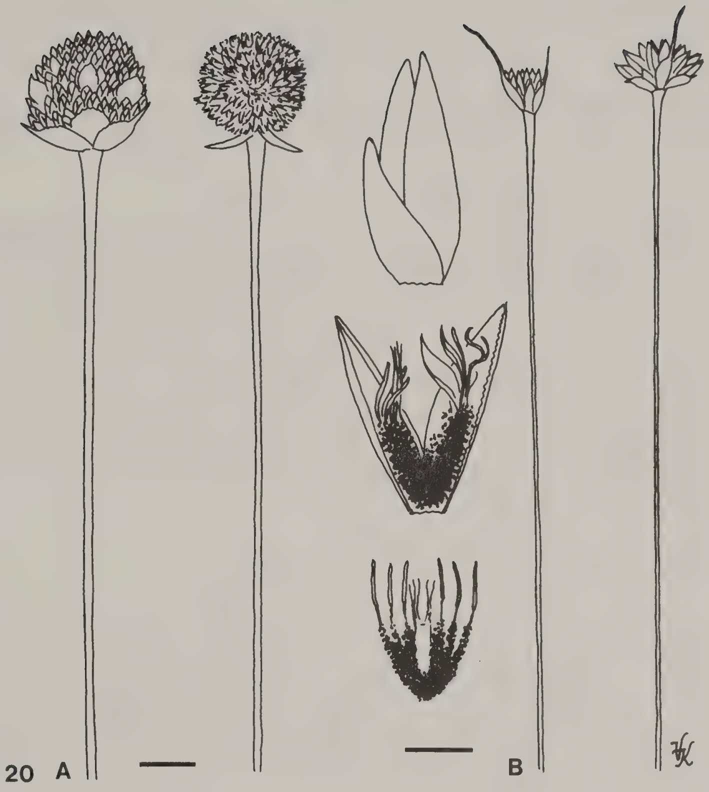

Fig. 20. Sori of *Tolyposporium gymnoschoenii* K. & C. Vánky. **A**. on *Gymnoschoenus sphaerocephalus* (R. Br.) Hooker fil. (type), and **B**. on *G. anceps* (R. Br.) C. B. Clarke (paratype). On left the healthy plants, on right the infected ones. Enlarged three infected spikelets of the paratype with glumes, with partly and with completely removed glumes. Bars = 1 cm and 2 mm, respectively.

Sori (Fig. 20) in spiculis, massa nigra, granuloso-pulverea glomerulorum sporarum in superficie filamentorum gynoeceique productorum completis. Spiculae infectae parum patefactae glomerulos sporarum gradatim dispergentes. Glomeruli sporarum (Figg. 17, 18) subglobosi, ovoidei, ellipsoidales usque elongati vel irregulares, 30–70(–80) x 35–110(–130) µm, atro-rufobrunnei usque opaci, e pluries decem sporarum firmiter unitarum compositi. Sporae (Fig. 17) subcuneiformes, elongatae vel raro subpolyedrice irregulares, visu superfaciali irregulariter polyangulares, 5–11 x 7–16 µm, visu mediano 6–20(–25) µm longae, atro-rufobrunneae; pariete superficiei liberae 1,5–2,5(–3) µm crasso, irregulariter verrucoso, cum poro germinationis pallido, rotundo, diametro cca. 1,5 µm, pariete laterum contingentium tenui (0,5–0,8 µm), levi.

Sori (Fig. 20) in the spikelets which are filled with the black, granular-powdery mass of spore balls, produced on the surface of the filaments and gynoeceum. Infected spikelets somewhat opened, gradually dispersing the spore balls. Spore balls (Figs. 17, 18) subglobose, ovoid, ellipsoidal to elongated or irregular, 30–70(–80) x 35–110 (–130) µm, dark reddish-brown to opaque, composed of dozens of firmly united spores. Spores (Fig. 17) subcuneiform, elongated or rarely subpolyhedrally irregular, in surface view irregularly polyangular, 5–11 x 7–16 µm, in median view 6–20(–25) µm long, dark reddish-brown; wall of the free surface 1.5–2.5 (–3) µm thick, irregularly verrucose, with a light, round germ pore of ca. 1.5 µm diameter, wall of contact sides thin (0.5–0.8 µm), smooth.

THE SMUT FUNGI OF *TRIODIINAE* (GRAMINEAE).

The following four genera belong to the subtribe *Triodiinae* (subfam. *Chloridoideae*, tribe *Eragrostideae*): *Triodia*, with ca. 35 species, *Plectrachne*, 16 spp., *Symplectrodia*, 2 spp., and *Monodia*, 1 sp. (Clayton & Renvoize, 1986). All species of *Triodiinae* are restricted to Australia, usually to arid places. [The North American "*Triodia*" species are actually *Tridens* species (comp. Hitchcock, 1950)]. On these only one smut fungus, *Ustilago altilis* H. Sydow, was reported on different *Triodia* species.

Ustilago altilis H. Sydow, 1937:23.

Type on *Triodia* sp., Australia, South Australia. VI.1935, comm. J. B. Clealand (destroyed in Berlin, during the second world war). Neotype on *Triodia* (designated here) *pungens* R. Br., Australia, Northern Territory, Tanami Desert, 2 km W.N.W. Refrigerator Well, 21°03' S, 130°43' E, 1.VII.1980, leg. P. K. Latz, det. J. Walker, DAR 37965. Isoneotypi VPRI 12653, Herb. Ustil. Vánky (HUV 11268), and in Vánky, Ust. exs. No. 418.

Sori (Fig. 21) in the distal part of the stems (destroying the inflorescence?), at first concealed by leaf sheaths and covered by a grey membrane of host origin lined by mycelia. Sori fusiform, bullate, 0.3–1 x 1–5 cm. Infected plants somewhat stunted and congested. The sorus membrane ruptures irregularly disclosing the black, semiagglutinated mass of spores surrounding the stem of the host. Spores globose, subglobose to broadly ellipsoidal, 7–11 x 7–12 µm, reddish-brown; wall 2.5–3 µm thick, densely, prominently verrucose.

I observed spore formation on the inner surface of the sorus membrane. Young spores are in chains, formed within the ramified sporogenous hyphae.

McAlpine (1910:155) reported this fungus on *Triodia mitchellii* Benth. from Queensland, under the name of *Ustilago hieronymi* Schröter (type on *Bouteloua ciliata* Grieseb., Argentina, a synonym of *U. buchloes* Ellis & Tracy, type on *Buchloë dactyloides* (Nutt.) Engelm., USA), which is a different fungus, as was demonstrated also by H. Sydow (1937:23).

Another smut fungus was recently collected on two different host plants belonging to the subtribe *Triodiinae*:

Ustilago triodiae K. Vánky, **sp. nov.**

Typus in matrice: *Triodia microstachya* R. Br., Australia, Western Australia, Kimberley region, 38 km W. Kununurra, Molly Springs, 15°49' S, 128°26' E, alt. 140 m, 22.II.1996, leg. A. A. Mitchell, C. & K. Vánky. Holotypus in PERTH, isotypus in Herbario Ustil. Vánky (HUV 17662) et in Vánky, Ust. exs. (ineditus). Paratypus in matrice *Plectrachne pungens* (R. Br.) C. E. Hubb., Australia, Western Australia, Kimberley region, 140 km S.W. Kununurra, Argyle Diamond Mine, 16°37' S, 128°13' E, 27.I.1996, leg. K. Dixon, Herb. Kings Park & Botanic Garden, Perth, isoparatypus in Herbario Ustil. Vánky (HUV 17663).

Sori (Figg. 22, 23) in caule florali inflorescentiaque, longi, cylindrici, 1–2 mm x 20–30 cm, aliquando cum ramulis brevibus, adpressis in parte distali eorum, residuis spicularum destructarum, primo membrana argentea origine matricali cooperti, illa in nonnullis locis irregulariter rupta et dissoluta, massam sporarum atrobrunneam, primo agglutinatam, deinde pulveream exponentes. Sporae (Figg. 24, 25) late ellipsoidales usque ovoideae, raro subglobosae, 7–10,5 x (8–)9–12 µm, flavidobrunneae; pariete cca. 0,8 µm crasso, moderate dense, uniformiter verrucoso-echinulato, lineam extremam sporae vix afficienter. Germinatio sporarum (Fig. 27; in MYP, temperatura conclavis, in 1 die) basidiis singulis, raro binis ex eodem loco productis, 2–3-cellularibus, satis variabilibus, magnitudine 2–4 x 8–30(–35) µm. In basidiis basidiosporae nonnullae, lateraliter et terminaliter productae ovoideae usque ellipsoidales, magnitudine 1,5–2,5 x 4–10 µm. Basidiosporae more cellularum fermenti succesive germinantes. Cellula basalis basidii saepe hypham longam, 1,5–2 µm crassam producens.

Sori (Figs. 22, 23) in the floral stem and inflorescence, long, cylindrical, 1–2 mm x 20–30 cm, sometimes with short, adpressed branches on their distal part, the remnants of destroyed spikelets, first covered by a silvery membrane of host origin which ruptures irregularly in several places and flakes away exposing the dark brown, first agglutinated, later powdery mass of spores. Spores (Figs. 24, 25) broadly ellipsoidal or ovoid, rarely subglobose, 7–10.5 x (8–)9–12 µm, yellowish-brown; wall ca. 0.8 µm thick, moderately densely, uniformly verrucose-echinulate which just affects the spore profile. Spore germination (Fig. 27; on MYP, at room temp., after one day) results in one, rarely two, 2–3-celled, rather variable basidia starting from the same place, measuring 2–4 x 8–30(–35) µm. On the basidia, laterally and terminally, several ovoid to ellipsoidal basidiospores are born, measuring 1.5–2.5 x 4–10 µm. The basidiospores germinate successively, like yeast cells. The basal cell of the basidium often

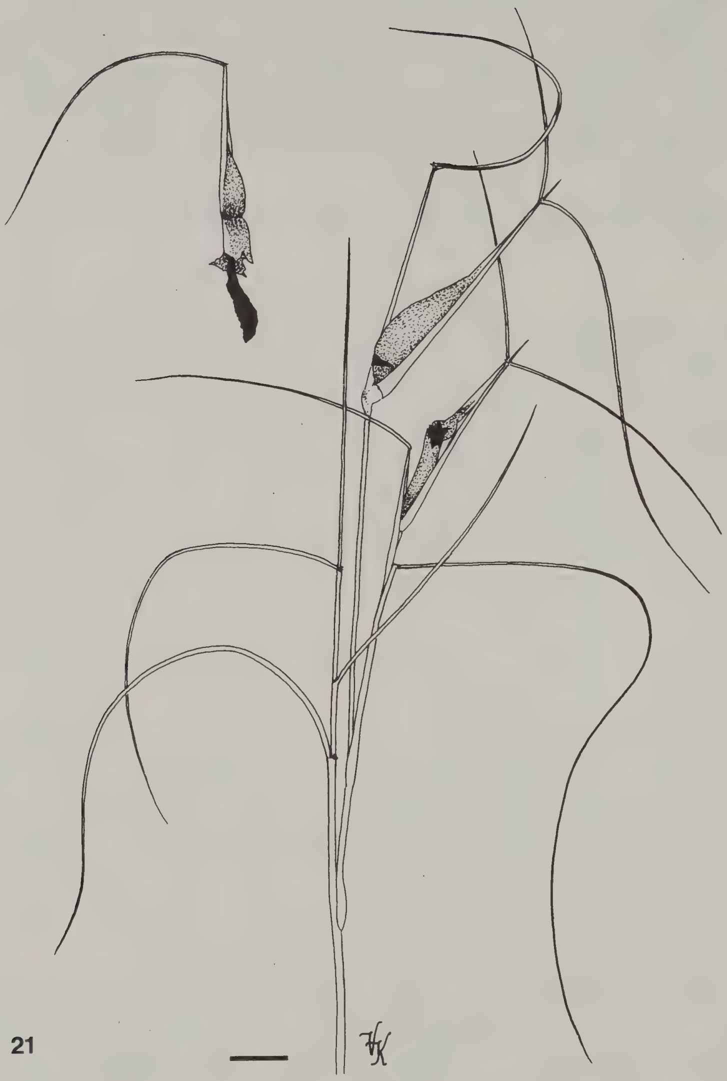

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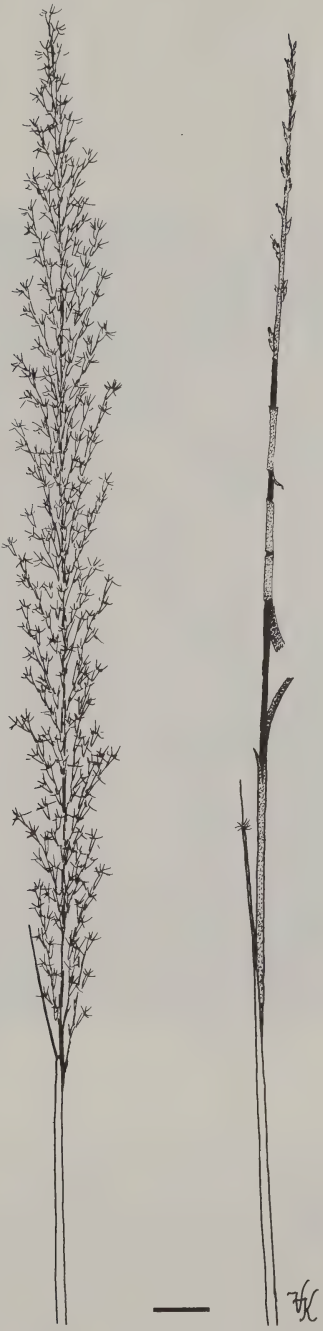
Fig. 21. Sori of *Ustilago altilis* H. Sydow on *Triodia pungens* R. Br. (neotype). Bar = 1 cm.

Fig. 22. Sori of *Ustilago triodiae* K. Vánky on *Triodia microstachya* R. Br. (type) and a healthy plant (left). Bar = 1 cm.



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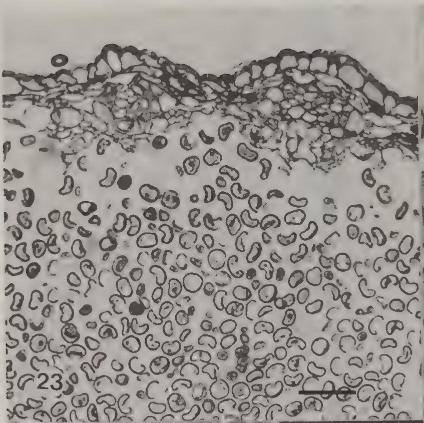

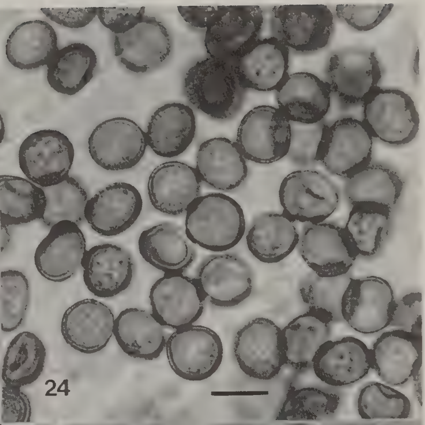

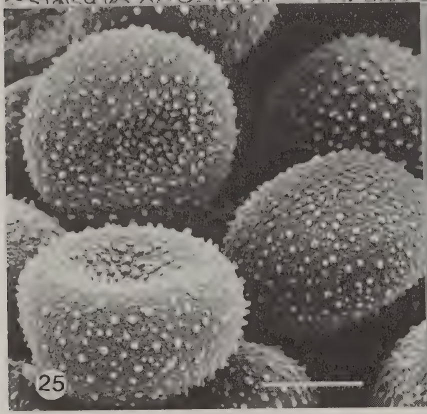

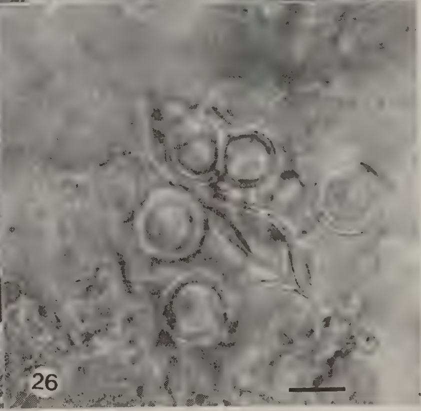

Figs. 23–25. *Ustilago triodiae* K. Vánky on *Triodia microstachya* R. Br. (type).

Fig. 23. Transversal section of a part of a young sorus with spore masses replacing the peripheral part of the parenchymatic tissue of the stem leaving intact the epidermis, the vascular bundles and the central part of the parenchimatic tissue (not seen on the picture). Bar = 25 µm.

Figs. 24, 25. Spores in LM and in SEM. Bars = 10 µm.

Fig. 26. Spores of *Entyloma bracteanthae* K. Vánky in the leaf tissues of *Bracteantha acuminata* (DC.) Anderberg & Haegi (type). Bar = 10 µm.

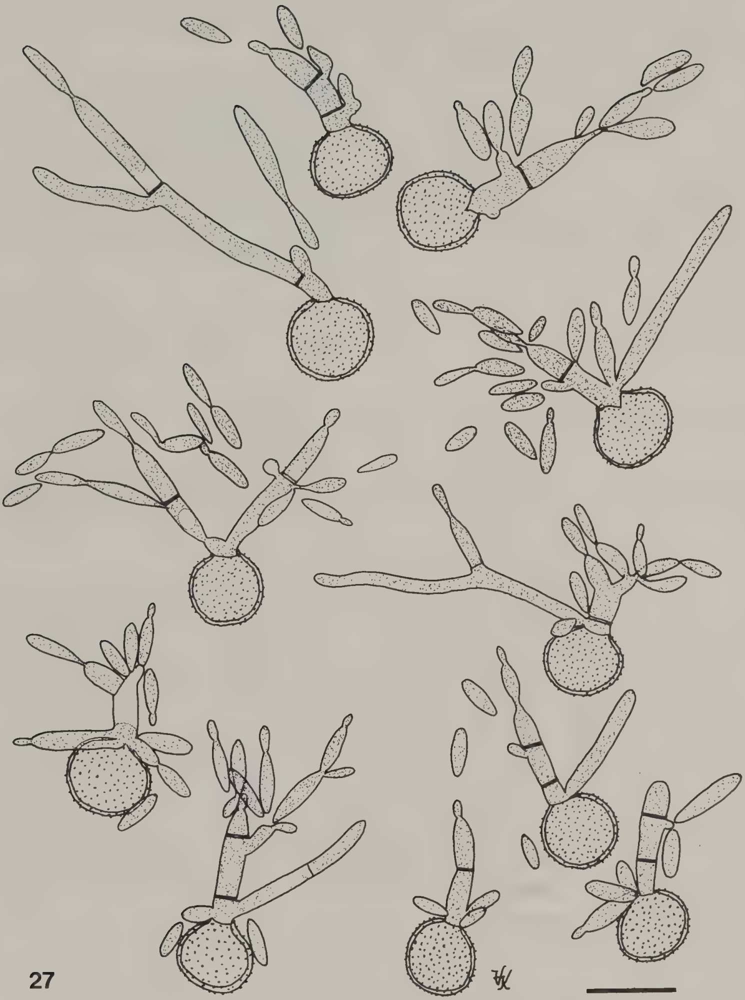

Fig. 27. Spore germination of *Ustilago triodiae* K. Vánky, showing 2- or 3-celled basidia, sometimes two 2-celled basidia from the same spore, producing ovoid or ellipsoidal basidiospores which bud like yeast cells (type; on MYP, at room temp., after one day). Bar = 10 µm.

produces a long hypha of 1.5–2 µm diameter.

The spores of the paratype are slightly smaller (7–10 x 8–11 µm) then those of the holotype (8–10.5 x 9–12 µm). This difference in the spore measurements is considered to lie within the variation of this species.

Ustilago triodiae belongs to the "*U. hypodytes* group", with 8 species (comp. Vánky, 1994:363). Most of these species have small spores, less than 10 µm. Regarding spore measurements, *U. triodiae* is closest to *U. jacksonii* Zundel & Dunlap (type on *Stipa lettermanii* Vasey, USA), with 10–14(–16) µm long spores. However, in *U. jacksonii* the spores are very variable, more elongated and the warts are not uniformly dispersed but usually 2 or 3 are grouped forming an irregularly verrucose surface pattern and causing a wavy appearance of the spore profile.

The occurrence of the same smut on both *Triodia microstachya* R. Br. and *Plectrachne pungens* (R. Br.) C. E. Hubb. denotes a close relationship between these two host plants.

A NEW *ENTYLOMA* ON *BRACTEANTHA* (COMPOSITAE).

Spots on leaves of *Bracteantha acuminata* (DC.) Anderberg & Haegi (subfam. Asteroideae), collected in Tasmania, are produced by an undescribed *Entyloma* species:

Entyloma bracteanthae K. Vánky, **sp. nov.**

Typus in matrice *Bracteantha acuminata* (DC.) Anderberg & Haegi (*Helichrysum acuminatum* DC.; det. A. Anderberg, S) Australia, Tasmania, ca. 80 km W. urbe Deloraine, (road No. 132, 20 km of junction with Hwy A 10) Mt. Mayday, 41°33' S, 145°53' E, alt. ca. 800 m, 13.III.1996, leg. K. & C. Vánky. Holotypus in HO, isotypi in Herb. Ustil. Vánky (HUV 17555) et in BPI.

Sori (Fig. 28) in foliis, maculas brunneas, orbiculares, planas, non erumpentes, magnitudine differentes, diametro ab 0,5 usque 3 mm, vel propter coalescentiam majores, saepe margine angusto, flavo instructas formantes. Sporae (Fig. 26) in telis matricis immissae, solitariae, in gregibus parvis vel in seriebus brevibus, globosae, subglobosae, ovoideae, late ellipsoidales vel aliquantum irregulares cum lateribus parum deplanatis, 8–14,5 x 9–16 µm, subhyalinae usque pallide flavae; pariete plus-minus aequali, 1–2(–2,5) µm crasso, levi.

Sori (Fig. 28) in the leaves as brown, orbicular, flat, nonerumpent spots of different sizes from 0.5 to 3 mm in diameter or larger by confluence, often with a thin, yellow border. Spores (Fig. 26) embedded in the host tissue, solitary, in small groups or short rows, globose, subglobose, ovoid, broadly ellipsoidal or somewhat irregular with slightly flattened sides, 8–14.5 x 9–16 µm, subhyaline to pale yellow; wall more or less even, 1–2(–2.5) µm thick, smooth.

Bracteantha is a small genus, endemic to Australia, with six known species. No *Entyloma* is known on *Bracteantha*. On the related *Helichrysum arenarium* (L.) Moench, a different smut, *Entyloma magnusii* (Ule) Woronin (*E. aschersonii* (Ule) Woronin), is known from Europe. The sori of *E. magnusii* form galls at the base of the stems, the spores are mostly irregular, measuring 10–17 x 11–21 µm, and the spore wall is unequal, 2–4(–5) µm thick.

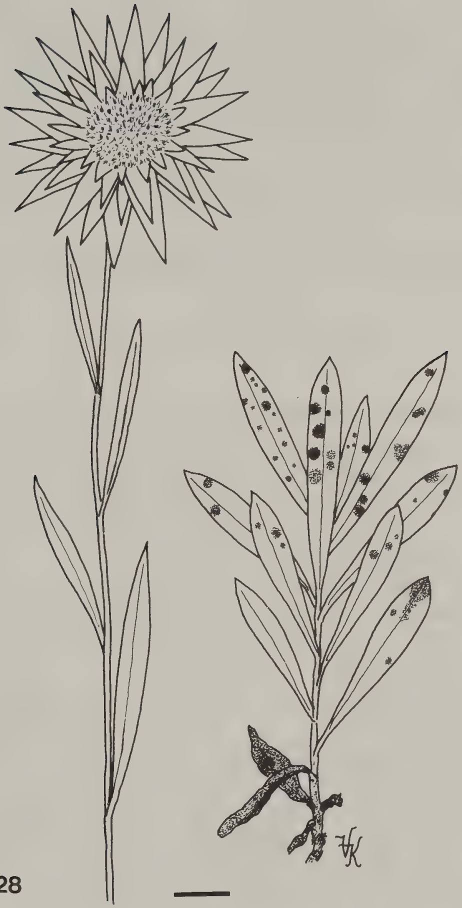

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Fig. 28 Sori of *Entyloma bracteanthae* K. Vánky in the leaves of *Bracteantha acuminata* (DC.) Anderberg & Haegi (type). Bar = 1 cm.

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LITERATURE CITED

Clayton, W. D. & Renvoize, S. A. 1986. Genera graminum. Grasses of the world. – London, 389 pp.

Cunningham, G. H. 1924. The Ustilagineae, or "Smuts", of New Zealand. – Trans. & Proc. New Zealand Inst. 55:397-433 + Pls. 41-47.

Hitchcock, A. S. 1950. Manual of the grasses of the United States. – Washington, U. S. Government Printing Office, 1051 pp.

Hooker, J. D. 1855. The botany of the Antarctic voyage, 2. Flora Novae-Zelandiae, Part 2. Berkeley, M. J. Flowerless plants. – London.

Langdon, R. F. N. 1977: *Dermatosorus* and *Zundelula* (Ustilaginales). – Trans. Brit. Mycol. Soc. 68:447-450.

Ling, L. 1948. Nota sinonímica sobre *Cintractia peribebuyensis* – Revista Argent. Agron. 15:254-255.

--- 1950. Studies in the genus *Cintractia*. II. *Cintractia axicola* and related species. – Mycologia 42:646-653.

McAlpine, D. 1910. The smuts of Australia, etc. – Melbourne, 285 pp.

Sydow, H. 1937. Neue oder bemerkenswerte australische Micromyceten. I. – Ann. Mycol. 35:22-49.

Sydow, H. & Sydow, P. 1919. Mykologische Mitteilungen. – Ann. Mycol. 17:33-47.

Thirumalachar, M. J. & Neergaard, P. 1977(1978). Studies on the genus *Tolyposporium. Tolyposporidium* gen. nov. – Friesia 11:177-192.

Thümen von, F. 1878. Symbolae ad floram mycologicam Australiae. II. – Flora 61:440-444.

Vánky, K. 1994. European smut fungi. – Gustav Fischer Verlag, Stuttgart, Jena, New York, 570 pp.

--- (in print). Taxonomical studies on Ustilaginales. XV. – Mycotaxon (24 pp.)

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THE SAXICOLOUS SPECIES OF THE GENERA *RINODINA* AND *RINODINELLA* LACKING SPOT TEST REACTIONS IN THE IBERIAN PENINSULA

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ABSTRACT: The morphology, anatomy, chemistry, ecology and distribution of twenty Iberian saxicolous *Rinodina* and *Rinodinella* species lacking spot test reactions are discussed, namely *Rinodina bischoffii, R. calcarea, R. cana, R. castanomela, R. dubyana, R. gennarii, R. guzzinii, R. immersa, R. insularis, R. interpolata, R. lecanorina, R. luridata*, *R. milvina, R. obnascens, R. parasitica, R. rinodinoides, R. teichophila, R. tunicata, Rinodinella controversa* and *R. dubyanoides*. *"Buellia" parvula* of uncertain taxonomic position is also included. New data on *Rinodina sicula* and *R. epimilvina*, two species containing secondary lichen compounds, are also provided. *Rinodina iodes* s. lat. is a synonym of *R. luridata, R. orcularia* of *R. bischoffii* and *R. orculariopsis* of *R. sicula*. The new combination *Rinodina bischoffii* var. *castanomelodes* is proposed. *Rinodina interpolata, R. parasitica* and *R. sicula* are reported for the first time from the area studied. A special note on the hitherto misunderstood *Rinodina arnoldii* is given. Some illustrations and a key to the species are included.

INTRODUCTION

The present study is a further contribution to a better knowledge of the saxicolous species of the genera *Rinodina* and *Rinodinella* in the Iberian Peninsula. Other saxicolous *Rinodina* species from the same area, that have recently been revised include those containing secondary lichen compounds which mostly can be detected after the application of reagents (GIRALT &

BARBERO 1995; GIRALT & al. 1996; MATZER & AL. 1994; MAYRHOFER & al. 1993).

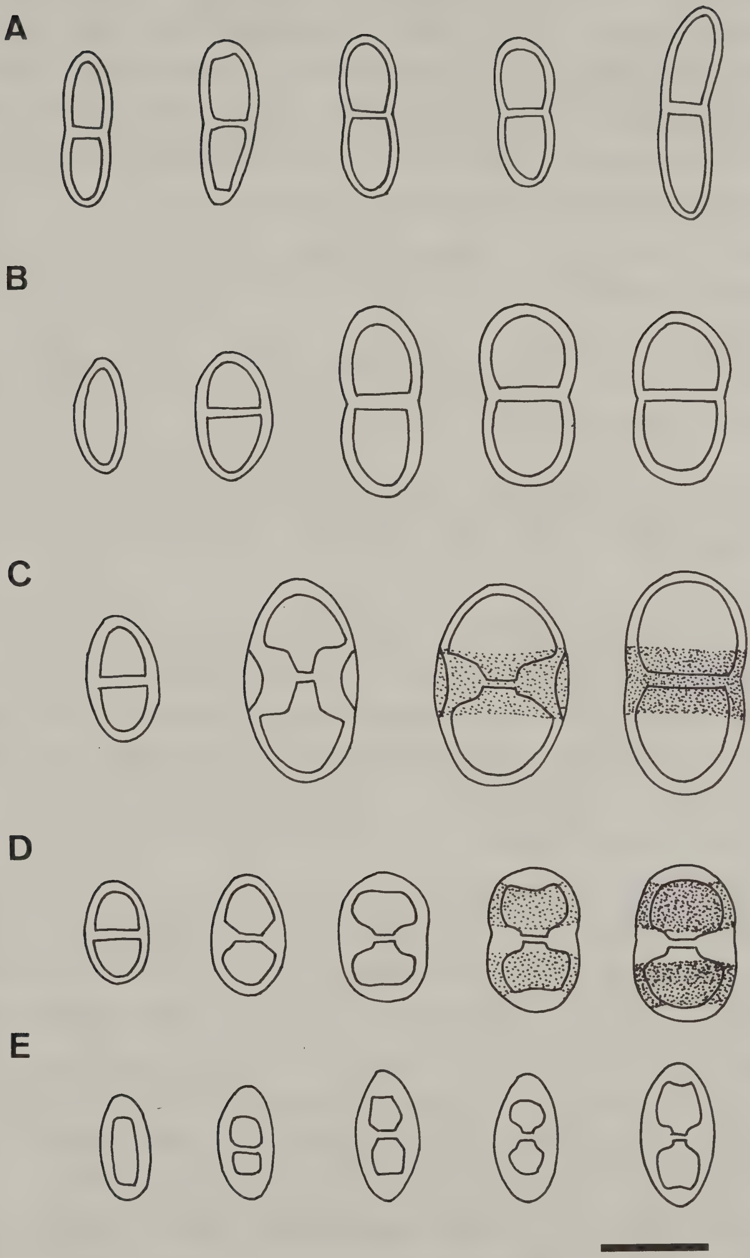
The species treated in the main taxonomic part of this paper are characterized by the total absence of secondary lichen compounds or by the presence of zeorin, a terpenoid which does not give spot test reactions.

It should be noted that, according to the literature (MAYRHOFER 1984a, 1987; MAYRHOFER & LEUCKERT 1985; MAYRHOFER & POELT 1979), *Rinodina sicula*, a saxicolous species present in the Iberian Peninsula, does not contain secondary lichen compounds. For this reason, *R. sicula* was not included in the revision of GIRALT & BARBERO (1995) which treated the Iberian saxicolous *Rinodina* species containing atranorin, pannarin or gyrophoric acid. Further studies have shown that the types of *R. sicula* (M-holotype, GZU-isotype), collections from the study area (VAB-2700, 2685) and specimens from other regions (GIRALT & al. in press) contain gyrophoric, lecanoric and orsellinic acids as well as usually traces of zeorin (compare GIRALT & al. in press). The Iberian data concerning *R. sicula* are given at the end of the present contribution. Other species mentioned there are *Rinodina arnoldii, R. epimilvina, R. lesdainii* and *R. venostana*. Those species have not been included in the key.

The ascospores of the species considered belong to ten different types: the *Rinodinella*-type in *Rinodinella controversa* and *Rinodinella dubyanoides* (Fig. 1A); the *Beltraminia*-type (= *Buellia*-type) in "*Buellia*" *parvula* (Fig. 1B); the *Bicincta*-type in *Rinodina castanomela, R. lecanorina* and *R. luridata* (Fig. 1D); the *Bischoffii*-type in *Rinodina bischoffii* s. lat., *R. guzzinii* and *R. immersa* (Fig. 1C); the *Dirinaria*-type in *Rinodina gennarii* and *R. insularis* (Fig. 1E); the *Milvina*-type in *Rinodina cana, R. milvina, R. obnascens* and *R. rinodinoides* (Fig. 2A-D); the *Mischoblastia*-type in *Rinodina teichophila* (Fig. 3C); the *Physcia*-type in *Rinodina interpolata* and *R. parasitica* (Fig. 3B); the *Physconia*-type in *Rinodina dubyana* (Fig. 3A) and the *Tunicata*-type in *Rinodina calcarea* and *R. tunicata* (Fig. 3D).

All the present species have ascospores which originate via a type A ontogeny except *Rinodina gennarii* and *R. insularis*, where the ascospores

Fig. 1: A, *Rinodinella*-type ascospores of *Rinodinella controversa* (MUB-889); **B,** *Beltraminia*-type ascospores of "*Buellia*" *parvula* (MARSSJ); **C,** *Bischoffii*-type ascospores of *Rinodina guzzinii* (Catalunya, Tivissa, 2.6.1988, P. Navarro-Rosinés, BCC); **D,** *Bicincta*-type ascospores of *Rinodina luridata* (L-holotype); **E,** *Dirinaria*-type ascospores of *Rinodina insularis* (hb. Barbero-193). Scale= 10 µm.


A
B
C
D
E

follow a type B ontogeny (Fig. 1E): in young ascospores the septum is inserted after apical wall-thickenings (compare GIRALT 1994; GIRALT & MAYROFER 1994a,b, 1995; MATZER & MAYRHOFER 1996). Two species, *Rinodina teichophila* and *R. calcarea,* have an ascospore-ontogeny which is somewhat intermediate between types A and B, with some young ascospores where the septum is inserted before apical wall thickenings and with some where it is inserted after apical wall thickenings become distinct (Fig. 3C).

Only one of the species considered, *Rinodina obnascens,* has vegetative propagules (blastidia).

Three species are obligately lichenicolous, *Rinodina insularis* on *Lecanora rupicola* coll., *R. obnascens* (usually) on *Aspicilia* spp. and *R. parasitica* on several crustose lichens.

The asci are of typical *Lecanora*-type in all the species treated (HONEGGER 1978, RAMBOLD & al. 1994) except in *Rinodina insularis* where they belong to the *Bacidia*-type.

The apothecia are lecideine in *Rinodina insularis*, pseudolecanorine almost from the beginning (DUGHY 1952, CLAUZADE & ROUX 1985, GIRALT 1994) in *Rinodina immersa, R. dubyana, R. rinodinoides, R. tunicata* and *Rinodinella dubyanoides* and ±persistently cryptolecanorine (SHEARD 1967) in *Rinodina cana, R. castanomela, R. lecanorina* and "*Buellia*" *parvula,* rather than typically lecanorine as occurs in the other species considered.

MATERIAL AND METHODS

All descriptions are based on our personal examinations. Current mycological terminology has been employed and generally follows that of HAWKSWORTH & al. (1995). The terminology used for the asci follows that of HONEGGER (1978) and RAMBOLD & al. (1994) while for the ascospore-types the terminology of MAYRHOFER (1982), SCHEIDEGGER (1993), GIRALT (1994), GIRALT & MAYRHOFER (1995) and MATZER & MAYRHOFER (1996) is followed. Standardized methods of thin layer chromatography (TLC) were employed (e.g. CULBERSON & AMMANN 1979; CULBERSON & al. 1981; CULBERSON & JOHNSON 1982) for the identification of lichen substances.

As most of the species considered have previously been described in detail in other revisional treatments, including those of SHEARD (1967, 1973), MAYRHOFER & POELT (1978, 1979), HAFELLNER (1979), MAYRHOFER (1983, 1984a-b, 1987), STEINER & MAYRHOFER (1987), MAYRHOFER & SHEARD (1988), MAYRHOFER & al. (1990, 1992), FOX & PURVIS (1992), MATZER & MAYRHOFER (1994, 1996) and GIRALT & al. (in press), the descriptions given here simply emphasize characters of value for species identification and do not repeat features common to all species.

Unless otherwise stated, notes on the ecology and distribution of the species refer to the study area.

KEY TO THE SPECIES

(*R.* = *Rinodina; Rinodinella* is not abbreviated)

1 Ascospores *Rinodinella*-type, very thin walled, pale brownish coloured and smooth (genus *Rinodinella*).
2

1* Ascospores different, not very thin walled, dark brown coloured and usually ornamented (genus *Buellia* or *Rinodina*).
3

2 Thallus epilithic, thick, areolate, sometimes effigurate, grey to dark brown. Apothecia lecanorine, up to 1,5 mm in diam.
Rinodinella controversa

2* Thallus indistinct, endolithic or epilithic but inconspicuous, whitish. Apothecia rapidly becoming pseudolecanorine, up to 0,6 mm in diam.
Rinodinella dubyanoides

3 Ascospores *Beltraminia*-type (= *Buellia*-type), without wall-thickenings, strongly ornamented.
"*Buellia*" *parvula*

3* Ascospores different, with more or less pronounced wall thickenings, not strongly ornamented.
4

4 Lichenicolous.
5

4* Not lichenicolous
7

5 Thallus absent or small brown thallus present. Apothecia lecideine, immersed in the host. Hypothecium brown. Asci of *Bacidia*-type. Ascospore-ontogeny of type B. Ascospores *Dirinaria*-type, 11-15 x 5,5-7(-8) µm. On *Lecanora rupicola* coll.
R. insularis

5* Thallus distinct. Apothecia lecanorine, not immersed in the host. Hypothecium colourless. Asci of *Lecanora*-type. Ascospore-ontogeny of type A. Ascospores different **6**

6 Thallus with vegetative propagules, blastidiate. Ascospores *Milvina*-type. Usually on *Aspicilia* spp. ***R. obnascens***

6* Thallus without vegetative propagules. Ascospores *Physcia*-type. On several crustose lichens. ***R. parasitica***

7 Ascospores *Tunicata*-type, with a thick outer wall. **8**

7* Ascospores different, without a thick outer wall. **9**

8 Thallus indistinct, endolithic or epilithic but inconspicuous. Apothecia rapidly becoming pseudolecanorine. Excipulum, hymenium and hypothecium interspersed with oil droplets. ***R. tunicata***

8* Thallus thick and well developed. Apothecia persistently lecanorine. Excipulum, hymenium and hypothecium not interspersed with oil droplets. ***R. calcarea***

9 Ascospores *Bischoffii*-type, with a heavily pigmented band around the septum. **10**

9* Ascospores different, without a heavily pigmented band or with two heavily pigmented bands, one around each lumen. **12**

10 Hymenium interspersed with abundant oil droplets. ***R. bischoffii* s. lat.**

10* Hymenium not interspersed with oil droplets. **11**

11 Thallus indistinct, endolithic to epilithic but inconspicuous. Apothecia pseudolecanorine from the beginning, immersed in deep depressions of the substratum. ***R. immersa***

11* Thallus distinct, well developed. Apothecia lecanorine, not immersed in depressions of the substratum. ***R. guzzinii***

12 Ascospores *Bicincta*-type, with two heavily pigmented bands, one around each lumen. Zeorin always present.
13

12* Ascospores different, without two heavily pigmented bands. Zeorin present or absent.
15

13 Hymenium interspersed with abundant oil droplets. Thallus thick to subsquamulose, dark brown.
R. castanomela

13* Hymenium not interspersed with oil droplets. Thallus indistinct to distinct but never subsquamulose, grey to ochraceous or pale brown.
14

14 Thallus epilithic, thick, grey. Apothecia cryptolecanorine to lecanorine, up to 1 mm in diam. Disc very rarely pruinose. Ascospores 13-20 x 7-12 μm.
R. lecanorina

14* Thallus endolithic to usually epilithic but thin, ochraceous to pale brownish. Apothecia lecanorine to pseudolecanorine, up to 0,6 mm in diam. Disc very often pruinose, at least in young apothecia. Ascospores significantly smaller, 10-16 x 7-11 μm.
R. luridata

15 Ascospores *Physconia*-type.
16

15* Ascospores different.
17

16 Thallus indistinct, endolithic to epilithic but inconspicuous. Apothecia pseudolecanorine from the beginning, ±immersed in depressions of the substratum.
R. dubyana

16* Thallus distinct, epilithic, well developed. Apothecia lecanorine, not immersed in depressions of the substratum.
R. guzzinii

17 Ascospores *Milvina*-type.
18

17* Ascospores different.
20

18 Apothecia lecideine from the beginning or pseudolecanorine but containing only a few algal cells in the excipulum. Ascospores 13-18 x 7-9,5 μm. Zeorin present.
R. rinodinoides

18* Apothecia cryptolecanorine to lecanorine, always containing abundant algal cells in the excipulum. Ascospores significantly larger, up to 24 x 13,5 µm. Zeorin absent.
19

19 Thallus dark grey brown to usually reddish brown. Prothallus present, black. Apothecia lecanorine, sessile, up to 1-1,5 mm in diam. Disc always epruinose (epihymenium without epipsamma).
R. milvina

19* Thallus pale grey to ochraceous or brownish, but never with a reddish tinge. Prothallus present or absent but margin of the thallus areolae often with a green pigment reacting N+ purple. Apothecia persistently cryptolecanorine, smaller, up to 0,6 mm in diam. Disc often ±pruinose (epihymenium with epipsamma).
R. cana

20 Ascospores *Mischoblastia*- to *Pachysporaria*-type, 18-28 x 10-15 µm.
R. teichophila

20* Ascospores different, smaller.
21

21 Ascospore-ontogeny of type B. Ascospores *Dirinaria*-type.
R. gennarii

21* Ascospore-ontogeny of type A. Ascospores *Physcia*-type.
R. interpolata

THE SPECIES

"BUELLIA" PARVULA (H. MAYRHOFER & POELT) **H. MAYRHOFER & SCHEIDEG.** *Lichenologist* **25**: 354 (1993).- Type: Macedonia, Sar planina, Popova sapka, W of Tetovo, ±2000 m, 8.7.1977, J. Poelt (GZU-holotype!).

Further information: MAYRHOFER & POELT (1979), MAYRHOFER (1984a), MAYRHOFER & LEUCKERT (1985), SCHEIDEGGER (1993) and RAMBOLD & al. (1994).

Thallus rather thick, cracked-areolate to areolate. Areolae contiguous, plane, smooth to cracked, whitish grey to grey. Prothallus absent. Apothecia cryptolecanorine to lecanorine but remaining immersed, abundant and confluent, 0,2-0,4(-0,5) mm diam. Thalline margin concolorous with thallus, very thin, persistent. Disc plane to subconvex, black. Hymenium 80-100 µm high. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Beltraminia*-type, 13-17(-19) x (6,5-)8-10 µm, strongly warted, torus poorly developed. Ascospore ontogeny of type A (Fig. 1B).

Chemistry: No substances were detected by TLC.

Discussion: The continuous, areolate and grey thallus lacking prothallus and zeorin, the small and immersed cryptolecanorine to lecanorine apothecia and the *Beltraminia*-type ascospores are diagnostic of "*Buellia" parvula*. Among the species treated it is unique in having this ascospore-type. "*Buellia" parvula* is clearly separated from the other species of the genus *Buellia* s. str. by its cryptolecanorine to lecanorine apothecia and its *Lecanora*-type asci. Although of uncertain taxonomic position (compare RAMBOLD & al. 1994), the characteristics above bring *"Buellia" parvula* close to the genus *Rinodina* and for this reason, it is included in this paper which is mainly devoted to species of the genus *Rinodina* and *Rinodinella.*

Ecology and distribution: "*Buellia*" *parvula* is a montane species which occurs in the alpine belt on calcareous rocks and has only been reported once from the Iberian Peninsula (NAVARRO-ROSINÉS & HLADUN 1990). It is a rare species known only from a few localities in the Alps and from the mountains of Macedonia (MAYRHOFER & POELT 1979, MAYRHOFER 1984a, SCHEIDEGGER 1993).

Additional specimens examined: Catalunya: Ripollès, Vall de Núria, Roc dels Eugassers, 2500 m, 17.7.1986, P. Navarro-Rosinés (BCC-4225, 4360). Coma de l'Embut, 2300 m, 17.7.1986, P. Navarro-Rosinés (BCC-4293, 4298, 4385, MARSSJ).

RINODINA BISCHOFFII **(HEPP) A. MASSAL.**
Fragmenti lichenographici: 26 (1855).- Type: Hepp: Flechten Europas 81 (L-isotype!).

New synonym: *Rinodina orcularia* H. MAYRHOFER & POELT, *Bibl. Lichenol.* **12**: 131 (1979).- Type: Germany, Oberbayern, Schlierseer Alpen, Nordgrat des Aiplspitz, über Geitau, 1600-1700 m, 2.6.1966, J. Poelt (GZU-holotype!).

Further information: SHEARD (1967), MAYRHOFER & POELT (1979), HECKLAU & al. (1981), MAYRHOFER (1983, 1984a-b, 1987), STEINER & MAYRHOFER (1987), FOX & PURVIS (1992), NIMIS (1993) and GIRALT & al. (in press).

Thallus almost indistinct to ±thick and well developed, discontinuously granulose to continuous and cracked, pale to dark grey. Apothecia lecanorine to rarely pseudolecanorine, sessile, (0,3-)0,5-0,7(-1) mm diam. Thalline margin entire, concolorous with, or darker than, the thallus, usually

persistent. Disc plane to convex, dark brown to black, often with a pruinose appearance. Hymenium interspersed with abundant oil drops. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Bischoffii*-type (Fig. 1C), 15-21 x 9-12 µm, torus absent. Ascospore-ontogeny of type A.
Chemistry: No substances were detected by TLC.

Discussion: *Rinodina bischoffii* shows a wide range of variation in thallus development, but the species is well characterized by its *Bischoffii*-type ascospores and its hymenium which contains abundant oil drops. Among the species treated, *R. guzzinii* and *R. immersa* possess the same ascospore-type but both are mainly distinguished by the lack of an interspersed hymenium. While *R. guzzinii* is very similar in habit to *R. bischoffii, R. immersa* has pseudolecanorine apothecia immersed in deep depressions in the substratum.
R. ocularia is here considered to be synonym of *R. bischoffii*. No difference was observed between the type of *R. ocularia* and the specimens of *R. bischoffii* examined (including the type specimen). According to MAYRHOFER & POELT (1979), *R. ocularia* has *Orcularia*-type ascospores but our investigations found that the ascospores of *R. ocularia* are of typical *Bischoffii*-type with a heavily pigmented band around the septum and wall thickenings of *Physconia*-type. The section *Orcularia* within the genus *Rinodina* was defined by MALME (1902) to include those species with polarilocular ascospores (called placodiomorph by SHEARD 1967). The corticolous *R. biloculata* is now the only European species in the genus which possesses *Orcularia*-type ascospores (compare GIRALT & MATZER 1994: Fig. 2C: 322 and Fig. 4C: 325). See also the discussion under *R. sicula*.

Ecology and distribution: *Rinodina bischoffii* has often been reported from the Iberian Peninsula (e.g. ALONSO & al. 1989, CASARES & LLIMONA 1986, CASARES & ROWE 1988, MAYRHOFER 1984a, EGEA 1985a, NAVARRO-ROSINÉS & HLADUN 1990 and TERRÓN & al. 1992). The species is widely distributed throughout Spain and occurs mainly in dry and warm areas, from the coast to inland and from low to high altitudes, sporadically reaching the alpine belt. It grows on the exposed surfaces of compact calcareous rocks and also often on pebbles on the ground. It can tolerate nutrient-enriched substrata. For its European distribution, see MAYRHOFER (1984a) and NIMIS (1993). It is also known from the southern hemisphere (MAYRHOFER 1983, 1984b).

Additional specimens examined: Spain: Andalucía: Granada, Sierra Nevada, Dornajo, 2070 m, 7.11.1981, M. Casares (GDA-1740). Sierra Nevada, Trevenque, 2070 m, 20.4.1983, M. Casares (GDA-1741). Sierra de

Baza, Calar de Sta. Bárbara, 2100 m, 9.7.1981, M. Casares (GDA-1747, 1750). Sierra de la Sagra, Collado de las Víboras, 1900 m, 20.7.1982, M. Casares (GDA-1732). Almería: Sierra Alhamilla, near cowboy town "Mini Hollywood", ca. 500 m, 3.8.1985, P.v.d. Boom (hb. Boom, BCC). Along the way from Gérgal to Las Aneas, ca. 800 m, 3.8.1985, P.v.d. Boom-2744 (hb. Boom).- Aragón: Huesca, between Jaca and Sabiñánigo, 820 m, 29.7.1975, K. Kalb-3742 (hb. Kalb).- Catalunya: Girona, Ripollès, Roc dels Eugassers, 2500 m, 17.7.1986, P. Navarro-Rosinés (BCC-4225, 4251, 4350). Sota el Pic de l'Àliga, 2400 m, 15.11.1986, P. Navarro-Rosinés (BCC-4386). Núria, N of Ribes de Freser, ca. 2300 m, 27.5.1983, H. Mayrhofer-3887 (BCC-3629). Lleida, 15 km south of Candasnos, 350 m, 28.8.1982, K. Kalb-15735 (hb. Kalb). La Segarra, Sanaüja, 500 m, 13.9.1983, P. Navarro-Rosinés (BCC-2725). Tarragona, Baix Camp, Vandellós, Barranc de Cala d'Oques, near Hospitalet de l'Infant, 6 m, 23.7.1986, P. Navarro-Rosinés & M. Boqueras (BCC). Pla de l'Albercoquer, near l'Hospitalet de l'Infant, 150 m, 18.10.1986, P. Navarro-Rosinés & al. (BCC). Terra Alta, Serra dels Ports, l'Horta de San Joan, Riu de l'Estret, 500-600 m, 9.2.1991, P. Navarro-Rosinés & N.L. Hladun (BCC). Barranc de les Closetes, 600 m, 9.2.1991, P. Navarro-Rosinés & N.L. Hladun (BCC). Montsianés, Serra dels Ports, La Sènia, Barranc del Retaule, 1000-1100 m, 14.2.1987, P. Navarro-Rosinés & al. (BCC). La Sènia, Barranc de la Fou, 750 m, 6.7.1988, P. Navarro-Rosinés & al. (BCC). La Sènia, Fageda del Retaule, 1100 m, 6.7.1988, P. Navarro-Rosinés & al. (BCC). La Sènia, between Vallcaneres Altes and Mola dels Conills, 1200 m, 14.2.1987, P. Navarro-Rosinés & al. (BCC). Priorat, la Torre de Fontaubella, Collet de la plana d'en Cervera, 500-550 m, 13.11.1987, P. Navarro-Rosinés & al. (BCC). Alt Camp, Massis de Bonastre, Masllorenç, Barranc de la Sequera, 200-300 m, 23.10.1987, P. Navarro-Rosinés & al. (BCC). Querol, near Esblada, 700-750 m, 21.2.1988, P. Navarro-Rosinés & al. (BCC). Baix Ebre, l'Ametlla de Mar, between Mas Rabosenc and Pedra Blanca, 100 m, 1.6.1988, P. Navarro-Rosinés & al. (BCC). Tivenys, Barranc del Xato, 100-150 m, 5.11.1988, P. Navarro-Rosinés & al. (BCC). Roquetes, Serra dels Ports, Barranc de la Caramella, 400-500 m, 19.10.1986, P. Navarro-Rosinés & al. (BCC) - Castilla-León: Soria, between Arcos de Jalón and Sta. María de Huerta, ca. 800 m, 24.5.1983, H. Mayrhofer-3635 (BCC-3632). Valladolid, La Santa Espina-Castromonte, 800 m, 20.3.1993, A. Terrón & A. Ubeda (LEB-216, 219).- Comunidad Valenciana: Castelló, Puerto de Querol, 1039 m, 10.10.1992, V. Calatayud & al. (VAB-2495).- Murcia: S of Cartagena, N of Portús, 75-150 m, 29.7.1985, P.v.d. Boom-2636, 2641 (hb. Boom, BCC). Mazarrón, Barranco de la Pistolera, 3.3.1983, J.M. Egea (MUB-9059). Bullas, Pico de la Selva, 800-1500 m, 20.6.1982, J.M. Egea (MUB-9058). Bullas, Salto

Lucero, 600 m, 6.2.1982, J.M. Egea (MUB-9055).- Navarra: Las Bárdenas Reales, ca. 10 km SE Caparroso, Barranco de Agua Salada, near Cabeza de la Junta, 340 m, 20.7.1993, J. Etayo & O. Breuss-9551 (hb. Breuss). Near Candévalos, 340 m, 20.7.1993, J. Etayo & O. Breuss-9568 (hb. Breuss).- Asturias: Picos de Europa, SE of Arenas de Cabrales, S of Sotres, from Vegas del Toro to Aliva, 1500 m, 25.7.1989, P.v.d. Boom-9064 (hb. Boom).- **Portugal,** Trás-os-Montes: Panacal, near Bragança, 14.4.1957, C. Tavares-5890 (LISU).

RINODINA BISCHOFFII VAR. _CASTANOMELODES_ (H. MAYRHOFER & POELT) GIRALT & LLIMONA COMB. ET STAT. NOV.

Basionym: *Rinodina castanomelodes* H. MAYRHOFER & POELT, *Bibl. Lichenol.* **12**: 81 (1979).- Type: Austria, Tirol, Pettneu, Arlberg, 29.8.1892, F. Arnold (M-holotype!).

Rinodina bischoffii var. *castanomelodes* differs from *R. bischoffii* var. *bischoffii* in thalline macroscopical characters, with the thallus of var. *castanomelodes* being usually thicker, ochraceous to brownish and made up of dispersed to continuous areoles.

Discussion: *Rinodina bischoffii* var. *castanomelodes* and var. *bischoffii,* are mainly characterized by the interspersed hymenium and the *Bischoffii*-type ascospores. *R. castanomelodes* was separated from *R. bischoffii* by MAYRHOFER & POELT (1979) only by the different habit (see above). According to our observations, *R. bischoffii* shows an extremely variable thallus morphology. The thallus may vary from endolithic and indistinct to epilithic and very well developed, from areolate to continuous and cracked, and from pale grey to dark grey or ochraceous or brownish. The apothecia may also vary from cryptolecanorine to adnate when the thallus is thick, to lecanorine and sessile when it is thin to indistinct. Furthermore, a gradual thalline and apothecial morphological variation can often be observed among different morphotypes which grow in a single specimen. For all these reasons, we consider that it is incorrect to treat *R. castanomelodes* as a separate species. Nevertheless, morphotypes with a thick, areolate and ochraceous to brown thallus and cryptolecanorine to adnate apothecia are known and have always been found growing at high altitudes. Consequently, we retain *R. castanomelodes* as a variety of *R. bischoffii*.

Ecology and distribution: *Rinodina bischoffii* var. *castanomelodes* has been reported only once from the Iberian Peninsula (NAVARRO-ROSINÉS & HLADUN 1990). Its European distribution is centered in the Alps. In the Pyrenees, it has been collected on sloping calcareous rocks in the alpine belt. For its European distribution, see MAYRHOFER (1984a) and NIMIS (1993), as *R. castanomelodes*.

Additional specimens examined: Spain: Catalunya: Ripollès, Vall de Núria, Roc dels Eugassers, 2500 m, 17.7.1986, P. Navarro-Rosinés (BCC-4378). Coma de les Mulleres, 2200 m, 15.11.1986, P. Navarro-Rosinés (BCC-4370). Sota el Pic de l'Àliga, 2400 m, 15.11.1986, P. Navarro-Rosinés (BCC-4386).

***RINODINA CALCAREA* (ARNOLD) ARNOLD**

Verh. zool.-bot. Ges. Wien **29**: 362 (1879).- Type: Arnold: Lich. exs. 161 (M-lectotype, GZU!, ZT- isotypes).

Further information: MAYRHOFER & POELT (1979), HECKLAU & al. (1981), MAYRHOFER (1984a), FOX & PURVIS (1992), NIMIS (1993) and GIRALT & al. (in press).

The following description is based on specimens from Vaucluse, Southern France (MARSSJ). None of the specimens collected in the Iberian Peninsula could be examined.

Thallus thick, continuous or discontinuous, rimose-areolate to areolate. Areolae smooth to granulose-verrucose, flat to convex, whitish grey to pale brownish, often with a pruinose appearance. Apothecia lecanorine, 0,5-0,8 mm diam, adnate to sessile. Thalline margin thick, persistent, concolorous with the thallus. Disc plane, brown. Hymenium up to 120 µm tall. Epihymenium reddish brown. Asci of *Lecanora*-type. Ascospores *Tunicata*-type (Fig. 3D), 20-26 x 11-15 µm, torus absent. Ascospore-ontogeny of both types, A and B.
Chemistry: No substances were detected by TLC.

Discussion: *Rinodina calcarea* is well characterized by the thick crustose thallus and the *Tunicata*-type ascospores. Another saxicolous species with *Tunicata*-type ascospores which occurs in the study area is *R. tunicata* which is readily distinguished by its inconspicuous thallus, pseudolecanorine apothecia and interspersed excipulum, hymenium and hypothecium. Furthermore, *R. calcarea* has an ascospore-ontogeny of both types, A and B while in *R. tunicata* it is always of type A.

Ecology and distribution: *Rinodina calcarea* has been reported several times from the Iberian Peninsula (MAYRHOFER & POELT 1979, MAYRHOFER 1984a and ALONSO & al. 1989). It is a rare species whose distribution in the study area is very poorly known. It has only been found in warm coastal localities in southern Spain, from low to middle altitudes, where it was growing on exposed calcareous rocks, often nutrient-enriched. For its European distribution, see MAYRHOFER (1984a) and NIMIS (1993).

RINODINA CANA (ARNOLD) ARNOLD
Verh. zool.-bot. Ges. Wien **30**: 125 (1880).- Type: Italy, Südtirol, Bozen, 8.1872, F. Arnold (M-lectotype!, M-isolectotype!).

Taxonomic note: The specimen Arnold: Lich. exs. 494, from Munich (M) which was reported as isotype in MAYRHOFER & POELT (1979) does not correspond to *R. cana*. It contains atranorin by TLC, possesses typical *Mischoblastia*-type ascospores and belongs to *Rinodina oxydata* s. lat. The isotype in ZT has not been studied.

Exs.: VEZDA: Lich. rar. exs. 187 (GZU).

Further information: MAYRHOFER & POELT (1979), MAYRHOFER (1984a), HECKLAU & al. (1981) and NIMIS (1993).

Thallus ±thick, cracked-areolate to areolate, well delimited. Areolae continuous, flat, grey to ochraceous to brown. Prothallus present or absent but base and margins of the thallus areolae usually brownish to greenish and then N+ purple. Apothecia cryptolecanorine to rarely lecanorine and then adnate, 0,2-0,4(-0,6) mm diam. Thalline margin concolorous with the thallus, thin, persistent. Disc concave to persistently plane, often with a pruinose appearance, pale to dark brown. Hymenium 100-110 µm high. Epihymenium orange brown, with an epipsamma of small crystals which dissolve in K. Asci *Lecanora*-type. Ascospores *Milvina*-type grading into the *Pachysporaria*-type when mature, (16-)18-22(-24) x 9-12(-13,5) µm, torus poorly developed. Ascospore-ontogeny of type A (Fig. 2A).
Chemistry: No substances were detected by TLC.

Discussion: *Rinodina cana* is well characterized by the continuous, cracked to areolate and grey to ochraceous thallus, the small cryptolecanorine apothecia and the large *Milvina*-type ascospores grading into the *Pachysporaria*-type when mature. An interesting feature which has always been observed in the ascospores of *R. cana* is that they possess a rather

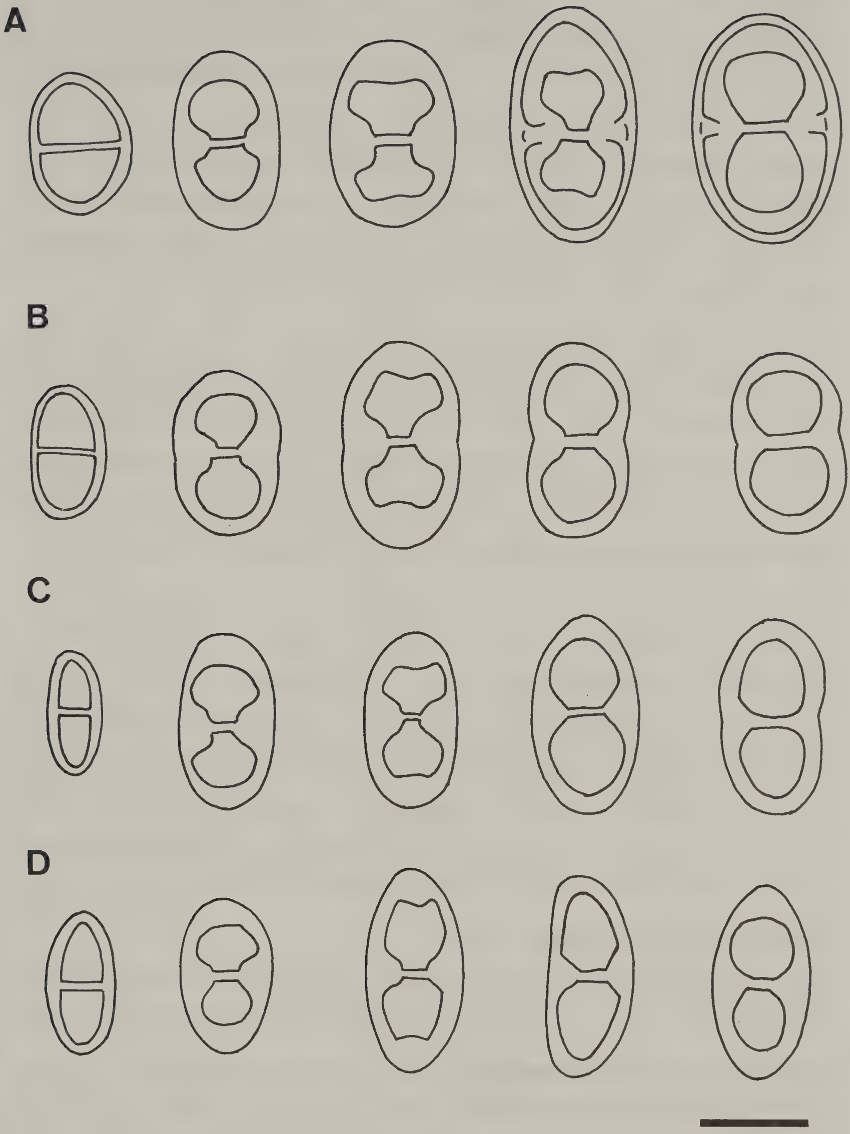


Fig. 2: *Milvina*-type ascospores of: **A,** *Rinodina cana* (M-lectotype); **B,** *R. milvina* (UPS-holotype); **C,** *R. epimilvina* (Castilla-León, Colgadizos, 4.8.1984, L.G. Sancho, MAF); **D,** *R. rinodinoides* (MUB-722). Scale= 10 µm.

thick intermediate layer (called W2 by SCHEIDEGGER 1993: 331). The same peculiarity can be present in *Rinodina milvina* (compare the description given by MAYRHOFER & SHEARD 1988: 111 under *Rinodina arnoldii*) and also in other *Rinodina* species, but it is constant in *R. cana* and, in our opinion, may constitute a distinguishing character.Among the species treated, *R. cana* can only be mistaken for *R. milvina* but this species is easily distinguished by the thicker and darker thallus, the larger lecanorine apothecia and the significantly smaller ascospores which furthermore always show a well developed torus. Their ecological preferences are also different (see ecology and distribution).

Ecology and distribution: *Rinodina cana* has been reported several times from the Iberian Peninsula (e.g. EGEA & LLIMONA 1981a, MAYRHOFER & POELT 1979, MAYRHOFER 1984a, ROWE & EGEA 1987, and CALATAYUD & BARRENO 1994), but its distribution is still poorly known. It occurs in warm localities in eastern Spain, mainly at low altitudes, on horizontal and exposed siliceous rocks, more or less nutrient- and base-enriched. This species is also known from only a few European localities (see MAYRHOFER 1984a, NIMIS 1993).

Additional specimens examined: Spain: Catalunya: Barcelona, Osona, La Noguerola, Riera Major de Viladrau, 650 m, 3.6.1985, X. Llimona & I. Pereira (BCC-5482).- Comunidad Valenciana: València, Puçol, El Picaio, 350 m, 26.2.1992, V. Calatayud (VAB-2597, 7326). Gilet, Sancti Spiritu, 300 m, 15.4.1993, V. Calatayud (VAB-2971). Castelló, Benicassim, Parreta Alta, 390 m, 22.4.1993, V. Calatayud (VAB-2933). Alfondeguilla, Pico Femella, 600 m, 20.1.1990, V. Calatayud (VAB-7325). Almonacid, Pico Espadà, 920 m, 24.3.1989, V. Calatayud (VAB-1795) - Murcia: Puerto Lumbreras, Sierra de Enmedio, 400-568 m, 8.8.1978, J.M. Egea (MUB-740).

RINODINA CASTANOMELA (NYL.) ARNOLD

Verh. zool.-bot. Ges. Wien **37**: 121 (1887).- Type: Italy, Südtirol, Paneveggio, 8.1884, F. Arnold (H-NYL-28966-holotype, not seen).

Further information: MAYRHOFER & POELT (1979), MAYRHOFER (1984a), HECKLAU & al. (1981) and NIMIS (1993).

Thallus areolate, areolae thick, crustose to subsquamulose, continuous, plane to subconvex, smooth, ochraceous brown to dark brown. Apothecia cryptolecanorine, up to 1 mm diam. Disc plane to subconvex, black. Hymenium interspersed with abundant oil droplets. Epihymenium brown. Asci *Lecanora*-type. Ascospores *Bicincta*-type (Fig. 1D), but dark bands often

poorly developed, 17-22 x (8-)9-10,5 µm, torus not developed. Ascospore ontogeny of type A.
Chemistry: Zeorin was detected by TLC.

Discussion: *Rinodina castanomela* is well characterized by the thick and dark brown thallus, composed of subsquamulose areolae and containing zeorin, the hymenium interspersed with abundant oil droplets and the *Bicincta*-type ascospores. In the study area, *R. lecanorina* and *R. luridata* which have the same ascospore type are easily separated by their less developed thalli, lack of oil droplets in the hymenium and significantly smaller apothecia and ascospores. Among the species treated *R. bischoffii,* which also contains an interspersed hymenium, is clearly distinguished by the *Bischoffii*-type ascospores.

Ecology and distribution: *Rinodina castanomela* has been reported only once from the Iberian Peninsula (NAVARRO-ROSINÉS & HLADUN 1990). Its European distribution is centered in the Alps. In the Pyrenees, it was collected on calcareous rocks in the alpine belt. Its distribution in the Iberian Peninsula is poorly known. For its European distribution, see MAYRHOFER (1984a) and NIMIS (1993).

Specimens examined: Spain: Catalunya: Girona, Ripollès, Vall de Núria, Coma de l'Embut, 2400 m, 17.7.1986, P. Navarro-Rosinés (BCC-4293). Núria, N of Ribes de Freser, ca. 2300 m, 25.5.1983, H. Mayrhofer-3886 (BCC-3627).

RINODINA DUBYANA **(HEPP) J. STEINER**

Verh. zool.-bot. Ges. Wien **69:** 60 (1919).- Type: Hepp: Flechten Europas 322 (M-syntype!).

Further information: MAYRHOFER & POELT (1979), MAYRHOFER (1984a, 1987), NIMIS (1993) and GIRALT & al. (in press).

Thallus indistinct, endolithic, or epilithic but inconspicuous, whitish to grey. Apothecia initially pseudolecanorine, immersed in depressions in the substratum, then ±adnate to sessile, brown to black, 0,3-0,5 mm diam. Disc plane to subconvex. Proper margin concolorous with the disc, thick and usually persistent. Hymenium 80-100 µm tall. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Physconia*-type (Fig. 3A), 14-18 x 8-10 µm, torus absent. Ascospore-ontogeny of type A.
Chemistry: No substances were detected by TLC.

Discussion: *Rinodina dubyana* is characterized by the indistinct to inconspicuous thallus, the pseudolecanorine apothecia initially ±immersed in depressions in the substratum and the *Physconia*-type ascospores. *R. immersa, R. tunicata* and *Rinodinella dubyanoides*, all rather similar in habit, differ mainly from *R. dubyana* by possessing *Bischoffii*-, *Tunicata*- and *Rinodinella*-type ascospores, respectively (see also comments under those taxa). The *Dubyana*-type ascospore sensu MAYRHOFER & POELT (1979) must be included in the *Physconia*-type as suggested by SCHEIDEGGER (1993) and GIRALT & al. (in press),

Ecology and distribution: *Rinodina dubyana* has been reported many times from the Iberian Peninsula (e.g. ALONSO & al. 1989, MAYRHOFER 1984a, NAVARRO-ROSINÉS & HLADUN 1990, RENOBALES & BARRENO 1990 and TERRÓN & al. 1992) but some records refer to *R. immersa, R. tunicata* and *R. bischoffii*. It occurs from the coast to inland and from low altitudes to the montane belt where it grows on sloping or horizontal ±exposed and preferently non-eutrophicated compact calcareous rocks. It has also been found on pebbles on the ground. It is widespread in central and southeastern Europe but very rare in the west (MAYRHOFER 1984a, NIMIS 1993). According to NIMIS (1993), *R. dubyana* is probably more frequent than the records suggest.

Additional specimens examined: Spain: Aragón: Zaragoza, Embalse de Mequinenza, N of Caspe, ca. 200 m, 25.5.1983, J. Poelt (BCC).- Andalucía: Jaén, S of Sierra del Pozo, SE of Puerto de Tiscar, 600 m, 17.7.1989, P.v.d. Boom-8789 (hb. Boom). Granada, Sierra Parapanda, 1550 m, 11.3.1982, M. Casares (GDA-1736, 1738). Cádiz, Grazalema, Cerro San Cristóbal, 1500 m, 15.10.1985, J.G. Rowe (GDA-1288, 1309).- Asturias: Picos de Europa, E of Cangas, SE of Arenas, from Sotres to Bulnes, ca. 1100 m, 13.8.1985, P.v.d. Boom-3332 (hb. Boom).- Cantabria: Santander, Picos de Europa, near Mirador el Cable, NW of Espinama, 1800 m, 30.7.1987, P.v.d. Boom-6201 (hb. Boom).- Catalunya: Tarragona, Montsianès, Serra dels Ports, La Sènia, Coll de la Creu, 1250 m, 6.7.1988, P. Navarro-Rosinés & al. (BCC). Alt Camp, Querol, near Esblada, 700-750 m, 21.2.1988, P. Navarro-Rosinés & al. (BCC). Priorat, La Torre de Fontaubella, Collet de la Plana d'en Cervera, 500-550 m, 13.11.1987, M. Giralt & P. Navarro-Rosinés (BCC). Lleida, La Segarra, Sanaüja, 500 m, 29.12.1982, P. Navarro-Rosinés (BCC-2727). 23.10.1983, P. Navarro-Rosinés (BCC-2728).- Madrid: Perales de Tajuña, 650-780 m, 1980, E. Barreno & A. Merino (MAF-3394).

RINODINA GENNARII BAGL.
Comment. Soc. Critt. Ital. **1**: 17 (1861).- Type: Italy, Liguria occidentale, "alle falde del monte Faiallo nell'Apennino di Voltri", F. Baglietto (WU-isotype, not seen).

Further information: SHEARD (1967, as *R. subexigua*), MAYRHOFER & POELT (1979), HEKLAU & al. (1981), MAYRHOFER (1983, 1984a-b, 1987), STEINER & MAYRHOFER (1987), FOX & PURVIS (1992), NIMIS (1993), MATZER & MAYRHOFER (1996) and GIRALT & al. (in press).

Thallus thin, continuous or not, smooth to ±granulose, whitish grey to greenish grey to greyish brown. Apothecia lecanorine, abundant and crowded, sessile, up to 0,5 mm diam. Thalline margin thin, entire, usually persistent, concolorous with, or darker than, the thallus. Disc plane to convex, dark brown to black. Hymenium 60-80 µm high. Epihymenium dark brown. Asci of *Lecanora*-type. Ascospore of *Dirinaria*-type (Fig. 1E), 11-16 x 6-9 µm, swelling around the septum with KOH, torus absent or, rarely, poorly developed. Ascospore-ontogeny of type B.
Chemistry: No substances were detected by TLC.

Discussion: The small, abundant and crowded apothecia, the small *Dirinaria*-type ascospores and the lack of lichen compounds are diagnostic of *R. gennarii*. *R. gennarii* cannot be mistaken for any of the other species treated because, apart from the lichenicolous *R. insularis,* it is the only other species to have *Dirinaria*-type ascospores.

Ecology and distribution: *Rinodina gennarii* has often been reported from the Iberian Peninsula (e.g. CRESPO & BUENO 1982, EGEA & LLIMONA 1981a-b, 1987, 1991, HLADUN & al. 1986, LÓPEZ DE SILANES & CARBALLAL 1991, RENOBALES & BARRENO 1990, TERRON & al. 1992, CALATAYUD & BARRENO 1993). It is a very common species widespread in Europe. In the study area, it occurs from the coast to inland, mainly at low altitudes and on exposed siliceous rocks, although it can occur on a wide variety of substrata such as schist, mortar and brick, particularly in rather nutrient-enriched situations. According to our field observations, *R. gennarii* is probably more common in the Iberian Peninsula than the records suggest. It is also known from the southern hemisphere (MAYRHOFER 1983, 1984b; MATZER & MAYRHOFER 1996).

Specimens examined: Spain: Andalucía: Almería, Los Lobos, Collado de la Casa Nueva, 370 m, 6.4.1977, J.M. Egea (MUB-742). Tabernas, Pico Alhamilla, 1360 m, 31.3.1979, J.M. Egea (MUB-738). Mojacar, 43-70 m, 15.4.1979, J.M. Egea (MUB-890).- Asturias: Oviedo, Luarca, on siliceous rock along the sea, 5-50 m, 11.8.1985, P.v.d.Boom-3302 (hb. Boom).- Comunidad Valenciana: Castelló, Columbret Gran, 50 m, 23.1.1993, V. Calatayud (VAB-2790). Castelló, Azuebar, Bco. Mosquera, 660 m, 10.2.1990, V. Calatayud (VAB-2560).- Castilla-La Mancha: Cuenca, Talayuelas, Pico Ranera, 1400 m, 18.7.1992, V. Calatayud (VAB-2868).- Catalunya: Barcelona, Osona, Viladrau, Montseny, La Noguerola, Torrent de Viladrau, 19.5.1985, X. Llimona (BCC-6373).

RINODINA GUZZINII JATTA

Nuovo Giorn. Bot. Ital. **23:** 354 (1891).- Type: Italy, Sicilia, Caccamo-Guardiola, 1.1890, Guzzino (NAP-holotype, not seen).

Further information: MAYRHOFER & POELT (1979, as *R. miocenensis*), MAYRHOFER (1984a), STEINER & MAYRHOFER (1987) and NIMIS (1993).

Thallus cracked-areolate, continuous, pale to dark grey, rarely discontinuous and poorly developed. Prothallus absent. Apothecia lecanorine, rarely becoming pseudolecanorine, adnate to sessile, up to 0,6 mm diam. Thalline margin concolorous with the thallus, entire, usually persistent. Disc plane to subconvex, dark brown to black, often with a pruinose appearance. Hymenium 80-120 µm high. Epihymenium brown. Asci *Lecanora*-type. Ascospores *Bischoffii*-type, but with dark band around the septum often poorly developed (= *Physconia*-type), (16,5-)18-21(-23) x (10-)11-13(-14) µm, torus not developed. Ascospore-ontogeny of type A (Fig. 1C).
Chemistry: No substances were detected by TLC.

Discussion: *Rinodina guzzinii* is characterized by the usually continuous, well developed, cracked-areolate and grey thallus which lacks a dark prothallus, the absence of zeorin, the lecanorine apothecia, the non-interspersed hymenium and the *Bischoffii*-type ascospores often showing a poorly pigmented band around the septum (grading into the *Physconia*-type). It is related to *R. bischoffii* from which it differs mainly by the lack of oil drops in the hymenium. *R. dubyana* and *R. immersa*, with somewhat similar ascospores, are easily separated by their indistinct thallus and pseudolecanorine apothecia, which, at least initially, are immersed in depressions in the substratum (see also comments under those taxa).

Ecology and distribution: *Rinodina guzzinii* has been reported infrequently from the Iberian Peninsula (e.g. BAEZA & al. 1989, BAEZA & EGEA 1991 and MAYRHOFER 1984a) but several records of *R. bischoffii* correspond to *R.*

guzzinii. It is a southern European species, rather rare and with a scattered distribution in the study area. It occurs mainly at low to middle altitudes, in dry and warm areas, from the coast extending inland, where it grows on ±horizontal exposed calcareous rocks such as oolitic limestones, and rarely on siliceous rocks enriched with lime. For its European distribution, see MAYRHOFER (1984a) and NIMIS (1993).

Specimens examined: Spain: Aragón: Zaragoza, 3km NE of Calatayud, ca. 430 m, 24.5.1983, H. Mayrhofer-3621 (BCC).- Murcia: Bullas, Sierra de Ponce y Quípar, Salto Lucero, 600 m, 6.2.1982. J.M. Egea (MUB-9057). Cehegin, Ribazo, 520 m, 16.4.1976, X. Llimona (MUB-9056).- Andalucía: Granada, Sierra Nevada, El Purche, 1300 m, 4.8.1985, P.v.d. Boom-3074 (hb. Boom). Almería, Sierra de los Filabres, from Gergal to Las Aneas, ca. 800 m, 3.8.1985, P.v.d. Boom-2735 (hb. Boom). SW of Mojácar, Sierra Cabera, 5 km SW of Turre, to Carrasca, 250 m, 12.7.1989, P.v.d. Boom-8649 (hb. Boom).- Asturias: Picos de Europa, SE of Arenas de Cabrales, S of Sotres, from Vegas del Toro to Aliva, 1500 m, 25.7.1989, P.v.d. Boom-9064 (hb. Boom).- Catalunya: Tarragona, Ribera d'Ebre, Tivissa, Barranc del Montalt, 300-400 m, 2.6.1988, P. Navarro-Rosinés & al. (BCC).

RINODINA IMMERSA **(KÖRB.) ARNOLD**

Flora **67:** 319 (1884).- Type: Germany, Bayern, F. Arnold (L-holotype!).

Further information: MAYRHOFER & POELT (1979), MAYRHOFER (1983, 1984a, 1987), FOX & PURVIS (1992), NIMIS (1993) and GIRALT & al. (in press).

Thallus indistinct (endolithic, or epilithic but inconspicuous), whitish to grey. Apothecia initially pseudolecanorine, immersed in deep depressions in the substratum, rarely becoming ±adnate, dark brown to black, 0,3-0,6 mm diam. Disc plane to subconvex. Proper margin concolorous with, or paler than, the disc, thin, usually persistent. Hymenium 80-100 µm tall. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Bischoffii*-type (Fig. 1C), 16-21 x 10-12 µm, torus absent. Ascospore-ontogeny of type A.
Chemistry: No substances were detected by TLC (FOX & PURVIS 1992).

Discussion: The pseudolecanorine apothecia, immersed in deep depressions in the substratum, and the *Bischoffii*-type ascospores are diagnostic of *R. immersa*. Among the species treated only *R. bischoffii* and *R. guzzinii* possess the same or similar ascospore-type. The former is distinguished from *R. immersa* by the interspersed hymenium, while the latter species has a better developed thallus with lecanorine apothecia which are never immersed in depressions in the substratum. It is noteworthy that two of the specimens examined (see below) were growing parasitically(?) on an unidentified and severely damaged species of *Caloplaca*.

Ecology and distribution: *Rinodina immersa* has often been reported from the Iberian Peninsula (e.g. ALONSO & al. 1989, CASARES & LLIMONA 1986, CASARES & ROWE 1988, EGEA 1985a, RENOBALES & BARRENO 1990) and is a common species, widespread throughout Spain. It occurs from the coast to inland, and from low to high altitudes, mainly on dry and sunny surfaces of horizontal or sloping compact calcareous rocks. It also occurs on pebbles on the ground and can tolerate a certain degree of eutrophication. It is also known from the southern hemisphere (NIMIS 1993). For its European distribution, see MAYRHOFER (1984a) and NIMIS (1993).

Additional specimens examined: **Spain:** Andalucía: Granada, Sierra Havana, Cueva del Agua, 1600 m, 16.6.1982, M. Casares (GDA-1731, 1753, 1756,1757). Sierra Baza, Calar de Sta. Bárbara, 2100 m, 9.7.1981, M. Casares (GDA-1734). Sierra Parapanda, 1550 m, 11.3.1982, M. Casares (GDA-1733, 1735, 1737). 4.6.1981, M. Casares (GDA-1755, 1759). 30.4.1982, M. Casares (GDA-1748). Sierra Sagra, 2100 m, 29.7.1982, M. Casares (GDA-1752).- Asturias: Picos de Europa, SE of Arenas de Cabrales, S of Sotres, from Vegas del Toro to Aliva, 1500 m, 25.7.1989, P.v.d. Boom-9082 (hb. Boom).- Cantabria: Santander, Picos de Europa, NW of Espinama, 200 m NW of Horcadina de Cobarrobres, 1950 m, 30.7.1987, P.v.d. Boom-6202 (hb. Boom).- Catalunya: Girona, Alt Empordà, Albanyà, Riu Muga, 25.11.1989, X. Llimona & I. Pereira (BCC-6321, 6322). Ripollès, Vall de Núria, Sota el Pic de l'Àliga, 2400 m, 15.11.1986, P. Navarro-Rosinés (BCC-4356, 4386). Pujada al Noucreus, 2400 m, X. Llimona & P. Navarro-Rosinés (BCC-4294). Tarragona: Baix Ebre, Benifallet, Serra del Cardó, Balneari del Cardó, 450 m, 6.11.1988, P. Navarro-Rosinés & al. (BCC). Baix Camp, Colldejou, between Portell el Llam and La Mola, 700-900 m, 13.11.1987, P. Navarro-Rosinés & al. (BCC). Alt Camp, Maslloreng, Massís de Bonastre, Barranc de la Sequera, 200-300 m, 23.10.1987, P. Navarro-Rosinés & al. (BCC). Priorat, la Torre de Fontaubella, Collet de la Plana d'en Cervera, 500-500 m, 13.11.1987, M. Giralt & P. Navarro-Rosinés (BCC). Terra Alta, Serra dels Ports, l'Horta de San Joan, Riu de l'Estret, 500-600 m, P.Navarro-Rosinés & N.L. Hladun (BCC). Barcelona: Baix Llobregat, Massís del Garraf, Castelldefels, Barranc de Vallbona, near Port Ginesta, 100 m, 9.7.1992, P. Navarro-Rosinés & al. (BCC).- Murcia: Bullas, La Lavia, 950 m, 30.1.1981, J.M. Egea (MUB-888).- Madrid: Perales de Tajuña, 650-780 m, E. Merino (MAF).

Specimens examined growing on *Caloplaca* sp.: Murcia: Mazarrón, Punta Negra, near Bolnuevo, 20 m, 30.9.1992, P. Navarro-Rosinés & al. (BCC).- Andalucía: Biescas, Falda del Peña Telera, Ibón de Piedrafita, 1600-1700 m, 4.9.1993, J. Etayo (BCC).

RINODINA INSULARIS **(ARNOLD) HAFELLNER**

Beih. Nova Hedwigia **62**: 87 (1979).- Type: Italy, Südtirol, Gröden, Augitporphyr ober Plan gegen das Sellajoch, 8.1895, F. Arnold (M-holotype, not seen).

Further information: HAFELLNER (1979), MAYRHOFER & POELT (1979), MAYRHOFER (1984a), TRIEBEL & al. (1991), RAMBOLD & TRIEBEL (1992), NIMIS (1993), MATZER & al. (1994) and RAMBOLD & al. (1994).

Lichenicolous on *Lecanora rupicola* coll. Thallus absent or small brown thallus present. Apothecia lecideine, immersed in the thallus of the host, 0,2-0,4(-0,5) mm diam, black. Proper margin concolorous with the disc, thin, becoming excluded. Hymenium 50-70(-80) µm high. Epihymenium dark brown. Hypothecium dark brown. Asci *Bacidia*-type. Ascospores *Dirinaria*-type, 11-15 x 5,5-7(-8) µm, strongly warted, torus absent. Ascospore ontogeny of type B (Fig. 1E).
Chemistry: TLC analyses were not carried out.

Discussion: *Rinodina insularis* is well characterized by the obligately parasitic growth, the small lecideine apothecia immersed in the thallus of the host, the dark brown hypothecium, the *Bacidia*-type asci and the small *Dirinaria*-type ascospores. Among the species treated it is unique in possessing all these characters. No proper thallus was seen in any of the specimens examined from the Iberian Peninsula (compare HAFELLNER 1979, TRIEBEL & al. 1991).

Ecology and distribution: *Rinodina insularis* has been reported several times from the Iberian Peninsula where it grows parasitically on *Lecanora rupicola* coll. on siliceous rocks (CALATAYUD & BARRENO 1993, 1994, CALATAYUD & al 1995, EGEA 1985b, HLADUN & al. 1986, MAYRHOFER 1984a, NAVARRO-ROSINÉS & HLADUN 1987 and RICO 1992). It occurs mainly in coastal localities at low to middle altitudes in the Mediterranean mountains. Its distribution is poorly known in Europe, from where it has been reported only from a few localities (e.g. HAFELLNER 1979, 1993, MAYRHOFER 1984a, NIMIS 1993). It is also known from North America, Australia (TRIEBEL & al. 1991) and Macaronesia (HAFELLNER 1995).

Specimens examined: Spain: Catalunya: Barcelona, Montseny, Coll Formic, 1200-1300 m, 28.5.1983, J. Hafellner (hb. Kalb-16596). Maresme, Dosrius, Can Massuet-El Far, 375 m, 28.2.1987, M. Barbero (hb. Barbero-179, 180, 181, 192, 193).- Comunidad Valenciana: València, Serra El Garbí, 575 m, 18.10.1992, V. Calatayud (VAB-2668, 2676). Castelló, Almonacid, Pico Espadà, 920 m, 24.12.1989, V. Calatayud (VAB-2565).

RINODINA INTERPOLATA (STIRT.) SHEARD

Lichenologist **5**: 461 (1973).- Type: Scotland, near Garvie, Ross-shire, 8.1887, J. Stirton (BM-holotype!).

Further information: SHEARD (1967, under *R. occulta*, 1973), MAYRHOFER & POELT (1979) and MAYRHOFER (1984a), LEUKERT & MAYRHOFER (1984), FOX & PURVIS (1992) and GIRALT & al. (in press).

Thallus thin, areolate to rimose-areolate. Areolae discrete to usually contiguous, plane, smooth, brown. Prothallus black. Apothecia lecanorine, often becoming pseudolecanorine, sessile, up to 0,4 mm diam. Thalline margin concolorous with the thallus, usually becoming excluded. Disc plane to subconvex, dark brown to black. Hymenium up to 80 µm tall. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Physcia*-type (Fig. 3B), grading into the *Milvina*- or *Physconia*-type when mature, 14-19 x 7,5-9 µm, torus absent to poorly developed. Ascospore-ontogeny of type A.
Chemistry: No substances were detected by TLC. In contrast to other studies (compare FOX & PURVIS 1992, GIRALT & al. in press), zeorin was detected by LEUCKERT & MAYRHOFER (1984) in a specimen from Sweden.

Discussion: *Rinodina interpolata* is characterized by the rimose-areolate to areolate thallus, lacking secondary lichen compounds, the black prothallus, the small apothecia, often becoming pseudolecanorine and the *Physcia*-type ascospores grading into the *Milvina*- or *Physconia*-type when mature. In the study area, *R. interpolata* could only be mistaken for *R. occulta* and *R. sicula*, but these two species contain secondary lichen compounds (atranorin and gyrophoric acid, respectively).

Ecology and distribution: *Rinodina interpolata* has not previously been reported from the Iberian Peninsula. Although little is known about the ecology of this species, the indications are that it has a preference for the mountains of the Atlantic region of the study area. All the specimens examined were collected in northern Portugal, where they were growing at middle to rather high altitudes on the sloping and shaded surfaces of hard siliceous rocks. For its European distribution, see SHEARD (1973), MAYRHOFER (1984a) and FOX & PURVIS (1992).

Additional specimens examined: **Portugal**, Minho: Serra do Gerez-Cha de Lamas, 8.7.1948, C. Tavares-2810, 2820 (LISU). Alberga, ca. 720 m, 2.7.1948, C. Tavares-2704 (LISU). Beira-Alta: Serra da Estrela, Vale do Zezere, ca. 1300 m, 3.8.1949, C. Tavares-3134 (LISU). Penhas da Saude, ca. 1600 m, 3.8.1949, C. Tavares-3114 (LISU). Senhora do Desterro, Vale do Alva, 13.9.1951, C. Tavares-4629 (LISU).

RINODINA LECANORINA **(A. MASSAL.) A. MASSAL.**
Geneacaena Lichenum: 19 (1854).- Type: Italy, Lombardia, Verona, Loveno, S. Garovaglio (VER-lectotype, not seen).

Further information: HUNECK & FOLLMANN (1970), HECKLAU & al. (1981), MAYRHOFER & POELT (1979, as *R. ocellata*), MAYRHOFER (1983, 1984a, 1987), MAYRHOFER & al. (1990), NIMIS (1993) and GIRALT & al. (in press).

Thallus thick, areolate. Areolae flat to subconvex, smooth, pale to dark grey or rarely greyish-brown. Prothallus absent but areolae brown at the base and often also at the margins. Apothecia cryptolecanorine to lecanorine, up to 1 mm in diam. Thalline margin concolorous with the thallus, persistent. Disc plane to subconvex, dark brown to black. Hymenium up to 90 µm tall. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Bicincta*-type (Fig. 1D), 13-20 x 7,5-12 µm, torus absent. Ascospore-ontogeny of type A.
Chemistry: Zeorin was detected by TLC. This substance was also reported by HECKLAU & al. (1981), HUNECK & SCHMIDT (1995) and GIRALT & al. (in press). HUNECK & FOLLMANN (1970) detected two unidentified substances.

Discussion: *Rinodina lecanorina* is characterized by the well developed thallus containing zeorin and composed of contiguous, large, smooth and grey areolae, the cryptolecanorine to lecanorine apothecia and the ascospores with a heavily pigmented band around each lumen. Among the species treated, *R. lecanorina* can only be mistaken for *R. castanomela* or *R. luridata*, both of which possess *Bicincta*-type ascospores. The former species is distinguished from *R. lecanorina* by the subsquamulose and dark brown thallus, the interspersed hymenium and the significantly larger ascospores while the latter species is separated by the less developed thallus and the smaller ascospores and apothecia which, initially at least, are covered with a fine whitish-grey pruina (compare MAYRHOFER & al. 1990).

Ecology and distribution: *R. lecanorina* has often been reported from the Iberian Peninsula (e.g. BAEZA & EGEA 1991, CASARES & LLIMONA 1986, CASARES & ROWE 1988, EGEA 1985a, MAYRHOFER 1984a, MAYRHOFER & al. 1990 and NAVARRO-ROSINÉS & HLADUN 1990) although some of these records correspond to *R. luridata* (e. g. NAVARRO-ROSINÉS & HLADUN 1990). It occurs throughout Spain, mainly in the mountains, in coastal as well as in continental localities, at low to high altitudes. It grows on calcareous rocks, usually at the top of high boulders, on horizontal and exposed surfaces which usually are nutrient-enriched by birds. According to CLAUZADE & ROUX (1977), it is characteristic of the *Dermatocarpetum monstrosi*. For its European distribution, see MAYRHOFER (1984a), MAYRHOFER & al. (1990) and NIMIS (1993).

Specimens examined: **Spain:** Andalucía: Granada, Sierra Parapanda, cumbre, 1550 m, 30.4.1982, M. Casares (GDA-1743, 1744, 1746, 1751). Granada, Alfacar, solana, 1350 m, 8.6.1979, M. Casares (GDA-1749).- Catalunya: Lleida, Central de Sanillers, Sobre Martinet, 900 m, 26.5.1983, J.M. Egea (MUB-1440). 2 km W of Martinet, 22 km E of Seu d'Urgell, ca. 980 m, 26.5.1983, H. Mayrhofer-3744 (BCC-3631).- Tarragona, Montsianès, La Sénia, Serra dels Ports, Fageda del Retaule, 1100 m, 14.2.1987, P. Navarro-Rosinés & al. (BCC). Barranc del Retaule, 1000-1100 m, 14.2.1987, P. Navarro-Rosinés & al. (BCC).- Murcia: Bullas, Sierras de Ponce y Quípar, Pico de la Selva, 800-1500 m, 20.6.1982. J.M. Egea (MUB-892, 9065, 9066).- Madrid: Perales de Tajuña, 650-780 m, 1980, A. Merino (MAF-3395).

RINODINA LURIDATA **(KÖRB.) H. MAYRHOFER, SCHEIDEG. & SHEARD**
Bibl. Lichenol. **38**: 346 (1990).- Type: Germany, Bayern, Bissingen, C.A. Kemmler (L-holotype!).

New synonyms: *Rinodina iodes* var. *iodes* H. MAYRHOFER & POELT, *Bibl. Lichenol.* **12**: 111 (1979).- Type: Austria, Virgental, Osttirol: S-exponierte Kalkschieferhänge etwa 1 km westlich Obermauer, ca. 1400 m, 24.3.1977, A. Buschardt-5372 (GZU-holotype!).- *Rinodina iodes* var. *immersa* H. MAYRHOFER & ROUX, in MAYRHOFER, *Journ. Hattori Bot. Lab.* **35**: 427 (1984).- Type: France, Var, entre Bargemon et le Plateau de Conjeurs, au-dessous et au S du Col du Bel Homme, 1000 m, 20.12.1980, C. Roux (GZU-holotype!, GZU!, hb Roux-isotypes).

Further information: CLAUZADE & ROUX (1977, 1985) and MAYRHOFER & POELT (1979), as *R. ocellata* and *R. iodes,* MAYRHOFER (1983, 1984a, also as *R. iodes,* 1987), MAYRHOFER & al. (1990) and NIMIS (1993).

Thallus indistinct (endolithic) or epilithic, from very thin and almost inconspicuous to thin but well developed, cracked-areolate or areolate. Areolae continuous or discontinuous, thin, plane, smooth, greyish to ochraceous to brown. Prothallus absent. Apothecia lecanorine to rarely pseudolecanorine, up to 0,5 mm diam. When the thallus is endolithic to almost indistinct, the apothecia can initially be ±immersed in depressions in the substratum. Thalline margin concolorous with the thallus, thin, usually persistent. Disc plane to subconvex, dark brown to black, often covered by a fine whitish grey pruina. Hymenium 70-100 µm high. Epihymenium reddish-brown. Asci *Lecanora*-type. Ascospores *Bicincta-type,* 10-16 x 7-11 µm, torus not developed. Ascospore-ontogeny of type A (Fig. 1D).
Chemistry: Zeorin was detected by TLC.

Discussion: *Rinodina luridata* is characterized by the almost indistinct to usually well developed but thin thallus, normally composed of discontinuous and ochraceous areolae which always contain zeorin, the small apothecia, initially covered by a fine whitish-grey pruina and the small *Bicincta*-type ascospores. *Rinodina lecanorina* and *R. castanomela* which are also present in the study area and have *Bicincta*-type ascospores, are distinguished by several thalline and apothecial characters (see also comments under these taxa).
As in other calcicolous *Rinodina* species (e.g. *R. bischoffii, R. guzzinii* and *R. tunicata*), the thallus of *R. luridata* varies in degree of development, consistency and colour according to the structure of the substratum: very thin, minutely granular and oxidised morphotypes growing on calcareous schists correspond to *R. iodes* var. *iodes*, whereas endolithic morphotypes growing on compact calcareous rocks correspond to *R. iodes* var. *immersa* and ±well developed and compact thalli which occur on other calcareous rocks are typical *R. luridata,* sensu Mayrhofer & al. (1990). In our opinion, as no additional differences could be observed between specimens of *R. iodes* s. lat. and those of *R. luridata*, there is no reason to keep *R. iodes* as a separate taxon.

Ecology and distribution: *Rinodina luridata* has only been once reported from the area studied (MAYRHOFER & al. 1990) but several records of *R. lecanorina* refer to this species (e. g. NAVARRO-ROSINÉS & HLADUN 1990). It is a widespread species throughout Europe, reaching the Mediterranean mountains where it occurs mainly in upland areas, always on calcareous rocks. According to CLAUZADE & ROUX (1977) it is a species characteristic of the *Aspicilietum calcareae*. It is also known from the southern hemisphere (MAYRHOFER & al. 1990). For its European distribution, see MAYRHOFER & al. (1990) and NIMIS (1993).

Additional specimens examined: Spain, Asturias: Picos de Europa, ca. 10 km SE of Covadonga, from Lago de la Encina to Llaguiello, 1250 m, 24.7.1989, P.v.d. Boom-9243 (hb. Boom).- Catalunya: Tarragona, Montsianès, La Sénia, Serra dels Ports, between Vallcaneres Altes and la Mola de Conills, 1200 m, 14.2.1987, P. Navarro-Rosinés & al. (BCC). Fageda del Retaule, 1100 m, 14.2.1987, P. Navarro-Rosinés & al. (BCC). Girona, Ripollès, Vall de Núria, 2300 m, 17.7.1986, P. Navarro-Rosinés (BCC-4296, 4297). Lleida, La Segarra, Sanaüja, 500 m, 1.7.1984, P. Navarro-Rosinés (BCC-2726).- **Portugal,** Trás-os-Montes: Panacal, near Bragança, 14.4.1957, C. Tavares-5890 (LISU).

***RINODINA MILVINA* (WAHLENB.) TH. FR.**

Nova Acta reg. Soc. Scient. Upsala, ser. 3, **3:** 224 (1861).- Type: Norway, Finmark, Jansnäset, Talviig, 29.5.1802, G. Wahlenberg (UPS-holotype!).

Further information: MAYRHOFER & POELT (1979), MAYRHOFER (1984a, 1987), LEUCKERT & MAYRHOFER (1984), FOX & PURVIS (1992), NIMIS (1993) and MATZER & al. (1994).

Thallus cracked-areolate to usually areolate. Areolae contiguous, plane to convex, smooth to irregular in surface, dark grey to reddish brown to dark brown. Prothallus present, black. Apothecia cryptolecanorine to usually lecanorine, adnate, rarely becoming sessile, 0,5-1(-1,5) mm diam. Thalline margin concolorous with the thallus, thick, smooth. Disc dark brown to black, concave to plane to rarely subconvex. Hymenium 100-120 µm high. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Milvina*-type, occasionally grading into the *Pachysporaria*-type when mature, (13-)16-19(-22) x (7-)9-11(-12,5) µm, often constricted at the septum, torus well developed. Ascospore-ontogeny of type A (Fig. 2B).
Chemistry: No substances were detected by TLC.

Discussion: *Rinodina milvina* is characterized by the well developed, grey brown to reddish-brown and areolate thallus lacking zeorin, the black prothallus, the large and sessile apothecia and the *Milvina*-type ascospores which always show a well developed torus. Among the species treated, *R.*

milvina can only be confused with *R. cana* but this species is well separated by the paler, thinner thallus (usually lacking a well developed prothallus), the smaller cryptolecanorine apothecia and the ascospores, which are significantly smaller than those of *R.* milvina and have only a poorly developed torus or not torus at all. The two taxa also differ in ecology and distribution. *R. parasitica,* which is also somewhat similar in habit, is distinguished mainly by the obligately lichenicolous growth, the smaller apothecia and the *Physcia*-type ascospores.
Another species closely related to *R. milvina* is the lichenicolous *R. obnascens* which is only separated from *R. milvina* by the blastidiate thallus and the obligately parasitic growth (see comments under *R. obnascens*).
Rinodina arnoldii has also been mistaken for *R. milvina* (see comments under excluded species).

Ecology and distribution: *Rinodina milvina* has often been reported from the study area (e.g. EGEA & LLIMONA 1981b, 1987, EGEA & al. 1982, HLADUN & al. 1986, MAYRHOFER & POELT 1979 and TERRÓN & al. 1992). It is a montane species rather common in north and central Europe, extending south to the mountains of the Mediterranean region were it has always been found at very high altitudes. It grows on siliceous rocks often enriched with traces of lime, usually on vertical and non-exposed surfaces. For its European distribution, see MAYRHOFER (1984a) and NIMIS (1993).

Additional specimens examined: Spain, Andalucía: Almería, Gérgal, Sierra de los Filabres, Piedra del Sombrero, 2000 m, 22.9.1979, J.M. Egea (MUB-741, 884). Andalucía: Granada, Sierra Nevada, Peñones de San Francisco, 2500 m, 28.9.1980, J.M. Egea (MUB-891).- Castilla-León: Avila, Sierra de Gredos, Colgadizos, 2100 m, L.G. Sancho (MAF, as *R. arnoldii*).- Catalunya: Barcelona, Montseny, Turó de l'Home, 1700 m, 23.10.1976, N.L. Hladun (BCC). Girona: Puig de Sa Carbassa, 1660 m, 15.11.1975, N.L. Hladun (BCC-6511). Girona, Núria, Pic de les Àligues, 2500 m, 27.5.1983, J.M. Egea (MUB-1292). Pirineus, Núria, N of Ribes de Freser, 27.5.1983, H. Mayrhofer-3783 (BCC, as *R. arnoldii*).

RINODINA OBNASCENS (NYL.) OLIV.

Bull. Acad. Int. Géogr. Bot. **12:** 380 (1903).- Type: France, Dept. Deux-Sèvres, Ile d'Yeu, 1884, Richard (H-Nyl-28749, holotype, not seen).

Further information: MAYRHOFER & POELT (1979), MAYRHOFER (1983, 1984a, 1987), FOX & PURVIS (1992), RAMBOLD & TRIEBEL (1992), NIMIS (1993) and MATZER & al. (1994).

Rinodina obnascens differs from *R. milvina* mainly by its blastidiate thallus, the lack or scarcity of apothecia and the obligately lichenicolous growth. In the study area it was always found growing on *Aspicilia* spp. Additional host genera (*Acarospora, Rhizocarpon*) were recorded by, e.g. MAYRHOFER (1987) and NIMIS & al. (1987).

Chemistry: TLC analyses were not carried out. According to MAYRHOFER & LEUCKERT (1985), *R. obnascens* does not contain secondary lichen substances by TLC.

Discussion: The blastidiate, dark reddish-brown thallus over a black prothallus, the *Milvina*-type ascospores and the obligately lichenicolous growth are diagnostic of *Rinodina obnascens*. Among the species treated it is unique in developing vegetative propagules.

Rinodina obnascens is characterized by the formation of blastidia (see POELT 1980, POELT & PETUTSCHNIG 1992) which most probably function as vegetative propagules. Thalli of *R. obnascens* can be entirely or only partly blastidiate. Specimens with a similar but smooth thallus growing parasitically on *Aspicilia* and completely lacking blastidia were included in *R. milvina*. This taxon also may have a lichenicolous behaviour but it is distinguished from *R. obnascens* by the lack of blastidia. As in *R. blastidiata* (MATZER & MAYRHOFER 1994), apothecia are often present in *R. obnascens* indicating that it can reproduce by sexual and asexual methods. The formation of blastidia is also known from other saxicolous and corticolous *Rinodina* species; compare MATZER & MAYRHOFER (1994, 1996), GIRALT & al. (1993, 1995) and ROPIN & MAYRHOFER (1995), respectively.

Ecology and distribution: *Rinodina obnascens* has been reported several times from the study area (e.g. EGEA & LLIMONA 1981b-c, 1987, 1991, EGEA & al. 1982, MAYRHOFER & POELT 1979, MAYRHOFER 1984a and VEZDA 1984). It is not infrequent in Spain and occurs mainly in the mountains at high altitudes although it can also occur at low altitudes in coastal localities. It always grows parasitically on *Aspicilia* spp., on horizontal surfaces of siliceous rocks. For its European distribution, see MAYRHOFER (1984a, 1987), NIMIS (1993) and HAFELLNER (1995).

Specimens examined: Spain: Andalucía: Granada, Sierra Nevada, Peñones de San Francisco, 2500 m, 28.9.1980, J.M. Egea (MUB-723, 726, 727). Guadix, Sierra de Baza, Padilla, 2000 m, 1.11.1978, J.M. Egea (MUB-725). Almería, Tabernas, Colativí, 1300 m, 31.3.1979, J.M. Egea (MUB-724).- Castilla-La Mancha: Albacete, Bienservida, Cañada del Conejo, 850 m, on *Aspicilia intermutans*, 27.5.1978, J.M. Egea & X. Llimona (VEZDA: Lich. sel. exs. 1964, hb. Kalb-12202, BCC-1992).- Castilla-León: Avila, Sierra de Gredos, Colgadizos, 2100 m, L.G. Sancho (MAF).- Catalunya: Girona, Cap de Creus, Port de la Selva, Can Puignau, 200 m, 6.8.1979, X. Llimona (BCC). Sant Pere de Rodes, La Vall, 500 m, 1.5.1973, X. Llimona (BCC).

RINODINA PARASITICA **H. MAYRHOFER & POELT**

Bibl. Lichenol. **12**: 137 (1979).- Type: Norwegen, Finnmark: Varangerfjord, Nordufer Paddeby, auf anstehendem Fels am Paddebyelven, 6.8.1969, A. Henssen-20133b (hb. Henssen-holotype, GZU-isotype!).

Further information: MAYRHOFER & POELT (1979), MAYRHOFER (1984a), RAMBOLD & TRIEBEL (1992), NIMIS (1993) and MATZER & al. (1994).

Thallus lichenicolous, rather thick, granulose-verrucose, continuous or not, dark reddish brown. Apothecia lecanorine, abundant and confluent, adnate to sessile, up to 0,5 mm diam. Thalline margin thick, smooth, prominent and persistent. Disc black, plane to rarely convex. Hymenium 70-100 µm high. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Physcia*-type, 16-21 x 8-11 µm, torus well developed. Ascospore-ontogeny of type A (Fig. 3B).

Chemistry: TLC was not carried out but the absence of crystals visible under polarized light indicates that *R. parasitica* probably lacks secondary lichen substances.

Discussion: *Rinodina parasitica* is well characterized by the reddish brown thallus growing parasitically on other crustose lichens, the small and abundant apothecia and the *Physcia*-type ascospores. It is unique among the species treated in having these features together. *R. milvina,* which is somewhat similar in habit, is mainly distinguished from *R. parasitica* by the larger apothecia and the *Milvina*-type ascospores.

Ecology and distribution: *Rinodina parasitica* is reported here for the first time from the Iberian Peninsula. The only collection examined was growing parasitically on an unidentified sterile crustose lichen, on a south-exposed slope with acid outcrops, at high altitude, in the Pyrenees. For its European distribution, see MAYRHOFER & POELT (1979), MAYRHOFER (1984a) and NIMIS (1993).

Additional specimen examined: **Andorra:** ENE of Andorra la Vella, Port d'Envalira, S exp. slope with acid outcrops in meadow, 2400 m, 8.8.1992, P.v.d. Boom-13626 (hb. Boom).

RINODINA RINODINOIDES **(ANZI) H. MAYRHOFER & SCHEIDEG.**
Nord. J. Bot. **12**: 454 (1992).- Type: Italy, Lombardia, Rhätische Alpen, Bezzolungo, M. Anzi (TO-holotype, UPS-isotype, not seen).

Further information: MAYRHOFER & POELT (1979) and MAYRHOFER (1984a, 1987), as *R. melanocarpa* and *R. serpentini*, MAYRHOFER & al. (1992) and NIMIS (1993).

Thallus thick, areolate. Areolae contiguous, plane to subconvex, smooth, whitish grey to grey. Prothallus absent. Apothecia lecideine to rarely pseudolecanorine, subimmersed to adnate, 0,5-1 mm diam. Proper margin thin, becoming excluded. Disc black, plane to convex. Epihymenium reddish brown. Hymenium up to 80 µm high. Hypothecium colourless to pale brown, ±interspersed with oil droplets, often with many overmature ascospores. Asci *Lecanora*-type. Ascospores *Milvina*-type, (13-)15-18(-19) x 7-9(-10) µm, torus absent or poorly developed. Ascospore-ontogeny of type A (Fig. 2D).
Chemistry: Zeorin was detected by TLC.

Discussion: *Rinodina rinodinoides* is characterized by the continuous, areolate and grey thallus containing zeorin, the lecideine apothecia rarely containing a few algal cells in the excipulum, the hypothecium commonly including overmature ascospores and the *Milvina*-type ascospores lacking a well developed torus. *Rinodina milvina* and *R. cana,* which both possess the same ascospore-type, are clearly separated by several thalline and apothecial characters. Furthermore, both species lack zeorin (see also comments under those taxa).

Ecology and distribution: *Rinodina rinodinoides* has been reported from the study area by EGEA (1985b), MAYRHOFER (1984a) and MAYRHOFER & al. (1992). It occurs in the alpine belt of the mountains of northern and southern Spain where it grows mainly on the south facing exposed surfaces of hard siliceous and mica schists rocks. It is a rare species known only from a few localities in Europe. For its European distribution, see MAYRHOFER & al. (1992) and NIMIS (1993).

Specimens examined: Spain, Andalucía: Granada, Sierra Nevada, Peñones de San Francisco, 2500 m, 28.9.1980, J.M. Egea (MUB-722, 723).- Catalunya: Girona, Núria, N of Ribes de Freser, 27.5.1983, J. Poelt (GZU).

RINODINA TEICHOPHILA (NYL.) ARNOLD
Flora **46:** 329 (1863).- Type: Mudd. Lich. Brit. exs. 108 (BM-isotype, not seen).

Further information: SHEARD (1967), HUNECK & FOLLMANN (1970), FOLLMANN & HUNECK (1972), MAYRHOFER & POELT (1979), MAYRHOFER (1984a, 1987), LEUCKERT & MAYRHOFER (1984), FOX & PURVIS (1992), MATZER & MAYRHOFER (1994), NIMIS (1993) and GIRALT & al. (in press).

Thallus thick, rimose-areolate to areolate. Areolae smooth to granulose-verrucose, pale to dark grey to brownish. Apothecia lecanorine, immersed to adnate, up to 1 mm diam. Thalline margin entire, persistent, concolorous with the thallus. Proper margin often visible as a ring within the thalline margin. Disc plane to convex, dark brown to black. Hymenium up to 125 µm high. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Mischoblastia*-type, showing tendencies towards the *Pachysporaria*-type when mature, 18-28 x 10-15 µm, swelling around the septum with KOH, torus absent. Ascospore-ontogeny of both types, A and B (Fig. 3C).
Chemistry: No substances were detected by TLC. Traces of atranorin were detected by mass spectrometry by LEUCKERT & MAYRHOFER (1984). According to the same authors, the presence of atranorin reported by HUNECK & FOLLMANN (1970) refers to *R. vezdae* and the report of atranorin and α-collatolic acid given in FOLLMANN & HUNECK (1972) is doubtful.

Discussion: *Rinodina teichophila* is characterized by the thick and rimose-areolate thallus (usually) lacking lichen compounds, the large lecanorine apothecia and the large *Mischoblastia*-type ascospores swelling around the septum in KOH.
In the study area, *R. teichophila* could only be mistaken for *R. oxydata* s. lat. However, the latter differs by the thinner and smoother thallus containing atranorin, the lecanorine to pseudolecanorine apothecia and the typical *Mischoblastia*-type ascospores (compare MATZER & MAYRHOFER 1994 and GIRALT & al. in press).

Ecology and distribution: *Rinodina teichophila* has only been reported a few times from the Iberian Peninsula (EGEA & LLIMONA 1981b-c, MAYRHOFER 1984a). It is a rather common species in temperate Europe (NIMIS 1993, MATZER & MAYRHOFER 1994), extending to the Mediterranean region and northern Europe, where it occurs from middle to rather high altitudes. It grows on siliceous rocks, particularly on moist fissures. It is also common on nutrient-enriched anthropogenic substrates such as brick or mortar. For its European distribution, see MAYRHOFER (1984a), NIMIS (1993) and (MATZER & MAYRHOFER 1994).

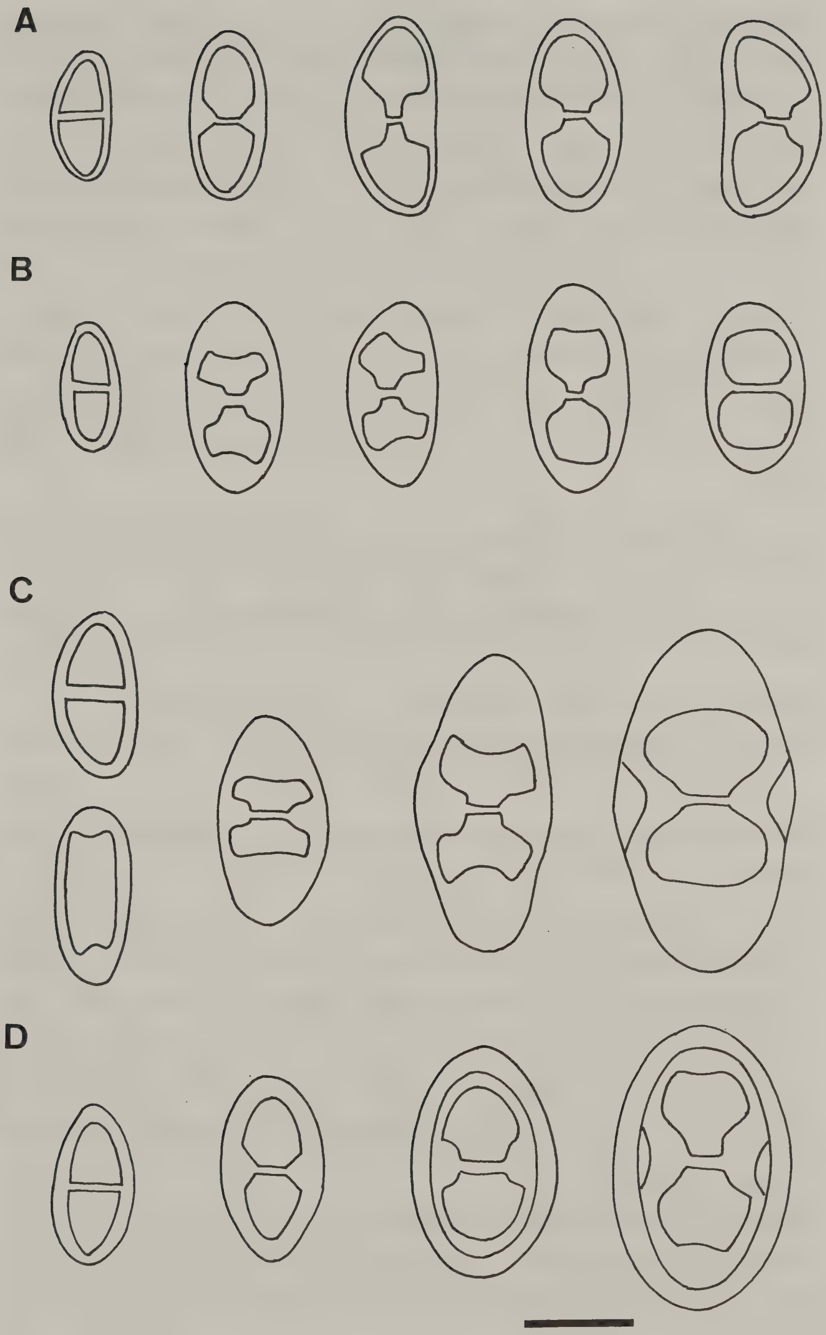
Specimens examined: **Spain**, Andalucía: Almería, Sierra de los Filabres, 18 km NWN of Sorbas, 1 km S of Pto. de la Virgen, 1000 m, 14.7.1989, P.v.d. Boom-8711 (hb. Boom). Road from Uleila del Campo to Albánchez, Monteagudo, 1200 m, 14.7.1989, P.v.d. Boom-10243 (hb. Boom). Barranco Barrancón, 1700 m, 1.4.1978, J.M. Egea (MUB-730).- Castilla-La Mancha: Albacete, Cáncarix, Sierra de las Cabras, 671 m, 17.4.1976, X. Llimona (MUB-728). Alcaraz, Reolid, 1000-1100 m, 24.3.1978, J.M. Egea (MUB-729).

RINODINA TUNICATA **H. MAYRHOFER & POELT**
Bibl. Lichenol. **12:** 153 (1979).- Type: Italy, Sicily, Enna, Mte. Cane, ca. 8 km NW of Pietraperzia, "Minniti", 400-450 m, 23.4.1978, I. Hertel & H. Hertel-19261 (M-holotype, GZU-isotype!).

Further information: MAYRHOFER & POELT (1979), MAYRHOFER (1984a, 1987), NIMIS (1993) and GIRALT & al. (in press).

Thallus usually indistinct (endolithic, or epilithic but inconspicuous), whitish to pale grey. Apothecia initially lecanorine, rapidly becoming pseudolecanorine, immersed to sessile, 0,5-0,8 mm diam. Thalline margin very thin, concolorous with the thallus, rapidly becoming excluded. Disc plane to subconvex, dark brown to black. Proper margin concolorous with the disc, usually thick, entire and persistent. Excipulum with many oil droplets. Hymenium up to 130 µm tall, usually ±interspersed with oil droplets. Epihymenium reddish brown. Hypothecium interspersed with abundant oil droplets. Asci *Lecanora*-type. Ascospores *Tunicata*-type, 18-24 x 10-14 µm, torus absent. Ascospore-ontogeny of type A (Fig. 3D).
Chemistry: No substances were detected by TLC.

Fig. 3: **A,** *Physconia*-type ascospores of *Rinodina sicula* (UPS-holotype of *R. orculariopsis*); **B,** *Physcia*-type ascospores of *R. parasitica* (GZU-isotype); **C,** *Mischoblastia*-type ascospores of *R. teichophila* (hb. Boom-9711); **D,** *Tunicata*-type ascospores of *R. tunicata* (MUB-892). Scale= 10 µm.


A
B
C
D

Discussion: *Rinodina tunicata* is characterized by the indistinct to inconspicuous thallus, the pseudolecanorine apothecia initially ±immersed in the substratum, the interspersed excipulum, hymenium and hypothecium and the *Tunicata*-type ascospores. *R. immersa* and *R. dubyana* are similar in appearance but have *Bischoffii*- and *Physconia*-type ascospores, respectively. *R. calcarea* which also possesses *Tunicata*-type ascospores is readily distinguished from *R. tunicata* by several thalline and apothecial characters (see also comments under those taxa).

Ecology and distribution: *Rinodina tunicata* has only been reported twice from the Iberian Peninsula, by BAEZA & al. (1989) and BAEZA & EGEA (1991). It is a Mediterranean species which occurs at middle altitudes in the mountains of southern Spain where it grows on calcareous rocks, particularly on dolomite. For its European distribution, see MAYRHOFER (1984a) and NIMIS (1993).

Additional specimens examined: **Spain:** Andalucía: Granada, Molinillo, 1300 m, 1.10.1982, M. Casares (GDA-1739). Sierra Loya, canteras, 900 m, 21.7.1983, M. Casares (GDA-1745).- Murcia: Bullas, Sierras de Ponce y Quípar, Pico de la Selva, 800-1500 m, 20.6.1982. J.M. Egea (MUB-892).

RINODINELLA CONTROVERSA **(A. MASSAL.) H. MAYRHOFER & POELT**
Hoppea, Denkschr. Regensb. Bot. Ges. **37**: 92 (1978).- Type: Massalongo: Lich. Ital. exs. 295 (M-lectotype, W-isotype, not seen).

Further information: MAYRHOFER & POELT (1978, 1979), HECKLAU & al. (1981), and MAYRHOFER (1984a).

Thallus thick, areolate, sometimes effigurate. Areolae contiguous, flat, smooth to slightly cracked, pale to dark olivaceous or dark brown. Prothallus rarely present, pale brown. Apothecia cryptolecanorine to lecanorine or rarely pseudolecanorine and then adnate, (0,5-)0,8-1(-1,3) mm diam. Thalline margin concolorous with the thallus, thick, smooth, entire, rarely excluded. Disc plane to convex, dark brown to black. Hymenium up to 100 µm high. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Rinodinella*-type, (13-)14-17(-20) x 5-6,5 µm, torus absent, smooth. Ascospore-ontogeny of type A (Fig. 1A).
Chemistry: No substances were detected by TLC.

Discussion: *Rinodinella controversa* is characterized by the thick, areolate, often effigurate and dark olivaceous to brown thallus, the large apothecia and the *Rinodinella*-type ascospores (see also comments under *R. dubyanoides*).

Ecology and distribution: *Rinodinella controversa* has been reported several times from the Iberian Peninsula (e.g. BARRENO & MERINO 1981, EGEA 1985a, CASARES & LLIMONA 1986, BAEZA & EGEA 1991 and ZOZAYA & ETAYO 1994). It is a Mediterranean-submediterranean species which occurs throughout Spain, mainly in the mountains but also in coastal as well as in continental localities, from rather low to high altitudes. It grows on calcareous rocks, usually at the top of high boulders, on horizontal and exposed surfaces which are usually nutrient-enriched by birds, often with *Rinodina lecanorina*. For its European distribution see, MAYRHOFER & POELT (1978), MAYRHOFER (1984a) and NIMIS (1993).

Specimen examined: **Spain:** Murcia: Bullas, Sierras de Ponce y Quípar, Pico de la Selva, 800-1500 m, J.M. Egea (MUB-889).

RINODINELLA DUBYANOIDES **(HEPP) H. MAYRHOFER & POELT**
Hoppea, Denkschr. Regensb. Bot. Ges. **37**: 98 (1978).- Type: Hepp: Flechten Europas 323 (M-syntype, not seen).

Further information: MAYRHOFER & POELT (1978, 1979) and MAYRHOFER (1984a).

Thallus indistinct (endolithic, or epilithic but usually inconspicous) to rarely granulose and then continuous to discontinuous, whitish to grey. Apothecia initially lecanorine and immersed in the thallus, becoming pseudolecanorine and sessile, dark brown to black, 0,2-0,4(-0,6) mm diam. Thalline margin thin, whitish, rapidly becoming excluded. Proper margin thick, prominent and entire, becoming thin, usually persistent. Disc concave to plane or subconvex. Hymenium 60-80 µm high. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Rinodinella*-type, 12-16(-18) x 5-6,5(-7,5) µm, smooth, torus absent. Ascospore-ontogeny of type A (Fig. 1A).
Chemistry: No substances were detected by TLC.

Discussion: *Rinodinella dubyanoides* is characterized by the indistinct to inconspicous and pale grey thallus, the small pseudolecanorine apothecia and the *Rinodinella*-type ascospores. *R. controversa* is distinguished from *R. dubyanoides* by the thicker, areolate and darker thallus and the larger lecanorine apothecia. *Rinodina dubyana*, which is similar in habit, is readily separated by its *Physconia*-type ascospores.

Ecology and distribution: *Rinodinella dubyanoides* has been reported several times from the Iberian Peninsula (EGEA & LLIMONA 1981a, SEAWARD 1983, MAYRHOFER 1984a, NAVARRO-ROSINÉS & HLADUN 1987). It is a Mediterranean-submediterranean species which grows on the exposed surfaces of hard calcareous rocks. For its European distribution, see MAYRHOFER & POELT (1978), MAYRHOFER (1984a) and NIMIS (1993).

Specimens examined: **Spain**: Catalunya: Tarragona, Baix Camp, Colldejou, between Portell el Llam i la Mola, 700-900 m, 13.11.1987, P. Navarro-Rosinés & al. (BCC). Alt Camp, Querol, 600-700 m, 21.2.1988, P. Navarro-Rosinés & al. (BCC).

Excluded species and previously overlooked saxicolous *Rinodina* species from the Iberian Peninsula.

RINODINA ARNOLDII **H. MAYRHOFER & POELT**

Bibl. Lichenol. **12**: 54 (1979).- Type: Germany, an einem Quarzfelsen der kahlen Schlucht gegenüber Kunstein bei Eichstätt, June 1859, F. Arnold (Arnold: Lich. exs. 68a, M-holotype!)

Further information: MAYRHOFER (1984a, 1987), MAYRHOFER & SHEARD (1988) and NIMIS (1993).

Note: The occurrence of *R. arnoldii* in the Iberian Peninsula is doubtfoul since all records refer to *R. milvina*. For this reason it is included among "excluded species".

Thallus rather thick, cracked-areolate to areolate, continuous, grey to greyish-brown. Areolae flat, smooth to slightly irregular in surface. Prothallus present only in some parts of the thallus and then poorly developed, normaly absent. Apothecia at first cryptolecanorine to lecanorine, rapidly becoming pseudolecanorine, adnate to subsessile, abundant, up to 0,6 mm diam. Thalline margin thin, entire, normally becoming excluded. Disc plane to subconvex, dark brown to black. Hymenium 90-110 µm high. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores of typical *Milvina*-type, some grading into the *Pachysporaria*-type when mature, (13-)15-17(-19) x (7-)8-9

µm, warted, torus absent or poorly developed. Ascospore-ontogeny of type A.
Chemistry: Zeorin was detected by TLC.

Discussion: *Rinodina arnoldii* is well characterized by the cracked-areolate to areolate, dark greyish-brown thallus, lacking a well developed prothallus and containing zeorin, the small apothecia usually becoming pseudolecanorine and the *Milvina*-type ascospores lacking a well developed torus.

Among the species treated, *R. cana, R. rinodinoides* and *R. milvina,* which also have the same ascospore-type, could be mistaken for *R. arnoldii*. *R. cana* is mainly distinguished from *R. arnoldii* by the paler thallus lacking zeorin, the smaller and persistently cryptolecanorine apothecia often showing plane, pale brown and ±pruinose discs and the significantly larger ascospores. *R. rinodinoides* appears to be much more closely related to *R. arnoldii* than *R. milvina* or *R. cana*. As *R. arnoldii*, it has small *Milvina*-type ascospores and it contains zeorin. The specimens of *R. rinodinoides* examined differ from the holotype of *R. arnoldii* mainly by the larger and often lecideine apothecia and the thicker thallus composed of larger, paler and smoother areolae. More specimens of *R. rinodinoides* and *R. arnoldii* need to be studied to determine the range of variability and to better establish any distinguishing characters, if present.

According to our investigations the original diagnosis of *R. arnoldii* given by MAYRHOFER & POELT (1979) and the second description in MAYRHOFER & SHEARD (1988) do not agree with the holotype of *R. arnoldii* (M) and may refer, at least in part, to another species, probably to *R. milvina.* MAYRHOFER & SHEARD (1988) suggest that *R. milvina* and *R. arnoldii* are closely related and mention several characters which distinguish *R. arnoldii*: lighter colouration of the thallus, high proportion of unilocular spores, stronger ascospore ornamentation and darker colouration of the outer part of the inner gelatinous layer of the ascospores. In our opinion, all these features fall within the variability of *R. milvina*. Therefore, a satisfactory separation of *R. arnoldii* and *R. milvina* as proposed by MAYRHOFER & POELT (1979), MAYRHOFER (1984a) and MAYRHOFER & SHEARD (1988) is not possible. On the other hand, an examination of several specimens previously identified by the authors above as *R. arnoldii* showed the specimens to be *R. milvina* (see under *R. milvina* “specimens examined"). A study of the holotypes of both species found them not to be conspecific. The description of *R. arnoldii* given above is based only on the holotype. The distinguishing characters between *R. milvina* and *R. arnoldii* are tried to be established just below.

R. milvina is differentiated from *R. arnoldii* by the better developed thallus and prothallus, the lack of zeorin, the larger and persistently lecanorine apothecia and the significantly larger ascospores which always show a well developed torus.

Ecology and distribution: *Rinodina arnoldii* has been erroneously reported from the Iberian Peninsula by EGEA (1985b) and SANCHO (1986). The specimens refer to *R. milvina*.

RINODINA EPIMILVINA H. MAYRHOFER
Journ. Hattori Bot. Lab. **55**: 408 (1984a).- Type: Italy, Südtirol, Kreuzjoch, 1893, E. Kernstock-9335 (W-holotype, not seen).

Further information: MAYRHOFER (1984a), RAMBOLD & TRIEBEL (1992), NIMIS (1993) and MATZER & al. (1994).

Note: According to MAYRHOFER (1984a) and our own TLC analyses, *Rinodina epimilvina* contains atranorin and zeorin. Although *R. epimilvina* has been reported once from the study area (SANCHO 1986), it was overlooked when preparing the revision of the saxicolous *Rinodina* species from the Iberian Peninsula containing atranorin, pannarin and gyrophoric acid (GIRALT & BARBERO 1995). For this reason, it is now mentioned here.

Discussion: *Rinodina epimilvina* is well characterized by the pale, areolate thallus which, at least in part, grows parasitically on *R. milvina*, the content of atranorin and zeorin, the cryptolecanorine to lecanorine apothecia and the *Milvina*-type ascospores measuring 15-19 x 7,5-9 µm (Fig. 2C).
Chemistry: Atranorin and zeorin were detected by TLC.

Ecology and distribution: *Rinodina epimilvina* has been reported from the Iberian Peninsula once (SANCHO 1986). It is a alpine species which grows parasitically on *R. milvina*, on non-exposed siliceous rocks. It was collected at high altitudes, in the continental mountains of central and southern Spain. For its European distribution see MAYRHOFER (1984a) and NIMIS (1993).

Specimens examined: Spain, Andalucía: Granada, Sierra Nevada, Peñones de San Francisco, 2500 m, 28.9.1980, J.M. Egea (MUB-723).- Castilla-León: Avila, Sierra de Gredos, Colgadizos, 2100 m, 4.8.1984, L.G. Sancho (MAF).

RINODINA LESDAINII SAMPAIO

Bot. Soc. Brot. ser. 2, **2:** 178 (1923).- Type: Portugal, Póvoa de Lanhoso, S gens de Calvos, nas lages de Paredes, 28.3.1929, G. Sampaio (W-syntype!).

Further information: SAMPAIO (1923), MAYRHOFER & POELT (1979) and MAYRHOFER (1984a).

Note: The identity of *Rinodina lesdainii* is doubtful but as it is known from the Iberian Peninsula (Portugal) it must be included in this contribution. More material belonging to this taxon must be examined to better establish its taxonomic value.

Discussion: The description of this lichen given in MAYRHOFER & POELT (1979) agrees with our own data except for the ascospores. According to our observations, the ascospores are closer to the *Milvina*-type rather than to the *Pachysporaria*-type. However, the apothecia of the type specimen are so severely parasited by an ascomycete (NAVARRO-ROSINÉS & al. in prep.), that is not possible to observe the ascospore-ontogeny and other microscopical characters.
Chemistry: No substances were detected by TLC.

Ecology and distribution: *R. lesdainii* is known from the type locality in Portugal, where it covered large surfaces of granite (SAMPAIO 1923), and, according to MAYRHOFER (1984a), from two additional localities in Switzerland and Morocco.

RINODINA SICULA H. MAYRHOFER & POELT

Bibl. Lichenol. **12**: 143 (1979).- Type: Italy, Sicilia, Messina, Monti Nebrodi, M. Trefinaite, Borgo Piedrapizzuta, 980-1100 m, 1.5.1978, I. Hertel & H. Hertel-19609 (M-holotype!, GZU-isotype!).

New synonym: *Rinodina orculariopsis* H. MAYRHOFER, *Journ. Hattori Bot. Lab.* **55:** 445 (1984a).- Type: Denmark, Bornholm, Kristiansö, Kildendal, 2.6.1937, P. Gelting (UPS-holotype!, C-isotype, not seen).

Further information: MAYRHOFER & POELT (1979), MAYRHOFER (1984a, 1987), MAYRHOFER & LEUCKERT (1985), NIMIS (1993) and GIRALT & al. (in press).

Note: According to MAYRHOFER & LEUCKERT (1985), *R. sicula* does not contain secondary lichen substances. For this reason, this taxon was not included in the revision of the Iberian saxicolous *Rinodina* which contain atranorin, pannarin and gyrophoric acid (Giralt & Barbero 1995). Our TLC analyses, however, showed that the type specimens (M, GZU) and other collections contained at least traces of gyrophoric, lecanoric and orsellinic acids and sometimes traces of zeorin. According to Mayrhofer (in litt.), the chemical data given in Mayrhofer & Leuckert (1985) may refer to an undescribed species rather than to *R. sicula*.

Thallus thin, rimose-areolate to areolate, continuous to discontinuous, pale to dark grey, or often with a pale ochraceous to reddish brown tinge. Prothallus present, black. Apothecia lecanorine, abundant and confluent, adnate to sessile, up to 0,5 mm diam. Thalline margin thin, entire to crenulate, persistent or not. Disc dark brown to black, plane to subconvex. Hymenium up to 100 µm high. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Physconia*-type, (14-)16-19(-21) x (7,5-)8,5-10 µm, torus well developed. Ascospore-ontogeny of type A (Fig. 3A).

Chemistry: Gyrophoric, lecanoric, orsellinic acids and sometimes traces of zeorin were detected by TLC.

Discussion: *Rinodina sicula* is characterized by the pale to dark grey and C+ red thallus (gyrophoric acid), the small, abundant and crowded lecanorine apothecia and the typical *Physconia*-type ascospores with a very well developed torus. It should be noted that the C+ red reaction, due to the presence of gyrophoric acid and its homologues, is often hardly visible, specially, when the specimens have dark brown thalli. In these cases, the test should be checked under the microscope.

According to Mayrhofer & Poelt (1979) and Mayrhofer (1984a, 1987), *R. sicula* possesses *Sicula*-type ascospores rather than *Physconia*-type. These two ascospore-types were distinguished by the same authors by the presence of a torus in the *Sicula*-type and its absence in *Physconia*-type. As already noted (compare e.g. Scheidegger 1993, Giralt 1994, Rambold & al. 1994, Matzer & Mayrhofer 1996 and Giralt & al. in press), the presence or absence of a torus should no longer be used for the definition of ascospore-types.

The study of the type and other specimens of *R. oculariopsis* from UPS has shown that this species is basically characterized by the content of gyrophoric and lecanoric acids with traces of zeorin (TLC) and the *Physconia*-type ascospores as in *R. sicula*. For this reason, *R. oculariopsis* is here considered to be a synonym of *R. sicula*.

Rinodina oculariopsis was described from Denmark by Mayrhofer (1984a). The species was distinguished from all other *Rinodina* species known by its

Orculariopsis-type ascospores. According to the same author, *Orculariopsis*-type ascospores have the same wall thickening as the *Orcularia*-type but the two types differ by the presence or absence of a torus. As this difference is not a valid character to separate ascospore-types (see above), the *Orculariopsis*-type should be included in the *Orcularia*-type. However, the *Orcularia*-type ascospores in the sense of MAYRHOFER & POELT (1979) and MAYRHOFER (1982, 1984a) do not correspond to the *Orcularia*-type ascospores as originally defined by MALME (1902) and followed by SHEARD (1967). These *Orcularia*-type ascospores were similar to the polarilocular spores found in the genus *Caloplaca* but with a brown pigment. MAYRHOFER (1984a) erroneously includes in his *Orcularia*-type (torus absent) and *Orculariopsis*-type ascospores (torus present), ascospores which have typical *Physconia*-type wall thickenings. Thus, *Orcularia* and *Orculariopsis*-type ascospores sensu MAYRHOFER (1984a) are simply *Physconia*-type ascospores. As already noted in the discussion of *R. bischoffii,* there is only one species in Europe which possesses true *Orcularia*-type ascospores sensu MALME (1902) and SHEARD (1967) and this is the corticolous *R. biloculata* (compare the illustrations in GIRALT & MATZER 1994: 322, 325).

Ecology and distribution: *Rinodina sicula* is reported here for the first time from the Iberian Peninsula. In the study area, it grows on siliceous rocks, at rather high altitudes in the Mediterranean coastal mountains. It appears to be more common in southern Scandinavia, British Isles, Benelux and France. For its European distribution, see MAYRHOFER & POELT (1979), MAYRHOFER (1984a), FOX & PURVIS (1992) and NIMIS (1993) and also as *R. orculariopsis*.

Additional specimens examined: Spain, Comunidad Valenciana: Castelló, Pina de Montalgrao, Sta. Bárbara, 1300 m, 21.3.1992, V. Calatayud (VAB-2685, 2700).

***RINODINA VENOSTANA* BUSCHARDT & H. MAYRHOFER**
in MAYRHOFER & POELT, *Bibl. Lichenol* **12**: 155 (1979).- Type: Italy, Südtirol, Vintschgau, NE Tartsch, ca. 1200 m, 4.1.1971, A. Buschardt (GZU-holotype!).

Note: The record of *Rinodina venostana* reported by CALATAYUD & BARRENO (1994) refers to *R. occulta.* According to our investigations, *R. venostana* has not been collected in the Iberian Peninsula.

Discussion: *R. venostana* is characterized by the thick, cracked-areolate and pale grey thallus lacking lichen substances, the large cryptolecanorine to

subimmersed lecanorine apothecia, often with coarsely pruinose discs and the *Physcia*-type ascospores measuring 15-20 x 7-11 µm.
Chemistry: No substances were detected by TLC.

Ecology and distribution: Compare MAYRHOFER & POELT (1979), MAYRHOFER (1984a) and NIMIS (1993).

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REFERENCES

ALONSO, F.L, J.M. EGEA & P.P. MORENO (1989) Flora liquénica, calcícola, del litoral de la provincia de Alicante. *Acta Botánica Malacitana* **14**: 59-71.

BAEZA, M.J. & J.M. EGEA (1991) Flora liquénica saxícola de Sierra Espuña (Murcia, España). *Anales de Biología* **17** (*Biología Vegetal*, 6): 93-104.

BAEZA, M.J., J.M. EGEA & P.P. MORENO (1989) Contribución a la flora liquénica del S.E. de España: líquenes interesantes de Sierra Espuña (Murcia, España). *Anales de Biología* **15** (*Biología Vegetal*, 4): 107-114.

BARRENO, E. & A. MERINO (1981) Catálogo liquénico de las calizas de Madrid (España). *Lazaroa* **3**: 247-268.

CALATAYUD, V. & E. BARRENO (1993) Fragmenta chorologica occidentalia, Lichenes, 4567-4631. *Anales del Jardín Botánico de Madrid* **51**: 130-133.

CALATAYUD, V. & E. BARRENO (1994) Contribution to the lichen floristics of eastern Spain - I. Silicicolous lichens and their lichenicolous fungi of Serra d'Espadà (Castellò). *Cryptogamie, Bryologie et Lichénologie* **15**: 23-41.

CALATAYUD, V. , V. ATIENZA & E. BARRENO (1995) Lichenicolous fungi from the Iberian Peninsula and the Canary Islands 1. *Mycotaxon* **55**: 363-382.

CASARES, M. & X. LLIMONA (1986) La clase *Verrucarietea nigrescentis* Wirth 1980 en las calizas béticas de la Provincia de Granada. *Cryptogamie, Bryologie et Lichénologie* **7**: 103-127.

CASARES, M. & J.G. ROWE (1988) Algunos líquenes calcícolas del Parque Natural de Grazalema. *Acta Botanica Malacitana* **15**: 290-296.

CLAUZADE, G. & C. ROUX (1977) Taxons nouveaux et intéressants pour le midi de la France. *Bulletin de la Société linnéenne de Provence* **30:** 9-36.

CLAUZADE, G. & C. ROUX (1985) Likenoj de Okcidenta Europo. Ilustrita determinlibro. *Bulletin de la Société Botanique du Centre Ouest. Nouvelle série. Numéro Spécial* **7:** 1-893.

CRESPO, A. & A.G. BUENO (1982) Flora y vegetación liquénicas de la Casa de Campo de Madrid (España). *Lazaroa* **4**: 327-356.

CULBERSON, C.F. & K. AMMANN (1979) Standardmethode zur Dünnschichtchromatographie von Flechtensubstanzen. *Herzogia* **5**: 1-24.

CULBERSON, C.F. & A. JOHNSON (1982) Substitution of methyl tert.-buthyl ether for diethyl ether in the standardized thin-layer chromatographic method for lichen products. *Journal of Chromatography* **238**: 483-487.

CULBERSON, C.F., W.L. CULBERSON & A. JOHNSON (1981) A standardized TLC analysis of β-orcinol depsidones. *Bryologist* **84**: 16-29.

DUGHY, R. (1952) Un problème de lichénologie non résolu: L'origine et la signification de l'apothécie lécanorine. *Annales de la Faculté de Sciences de Marseille*, Sér. 2, **21**: 219-243.

EGEA, J.M. (1985a) Líquenes calcícolas y terrícolas de las sierras de Pedro Ponce y Quípar (NW de Murcia, España). *Anales de Biología* **6** (*Biología Vegetal*, I): 19-27.

EGEA, J.M. (1985b) Algunos líquenes silicícolas interesantes de la Sierra de los Filabres (Almería) y Sierra Nevada (Granada, España). *Acta Botánica Malacitana* **10**: 3-10.

EGEA, J.M. & X. LLIMONA (1981a) Líquenes de rocas silíceas no volcánicas de localidades de escasa altitud del SE de España. *Anales de la Universidad de Murcia, Ciencias* **37:** 153-182.

EGEA, J.M. & X. LLIMONA (1981b) Líquenes silicícolas de la Sierra de los Filabres y Sierra Alhamilla (Almería, España). *Anales de la Universidad de Murcia, Ciencias* **37:** 107-152.

EGEA, J.M. & X. LLIMONA (1981c) Líquenes silicícolas de la Sierra del Relumbrar (Oeste de Albacete, España). *Lazaroa* **3**: 269-287.

EGEA, J.M. & X. LLIMONA (1987) Las comunidades de líquenes de las rocas siliceas no volcánicas del SE de España. *Acta Botanica Barcinonensia* **36**: 1-123.

EGEA, J.M. & X. LLIMONA (1991) Phytogeography of silicicolous lichens in Mediterranean Europe and NW Africa. *Botanika Chronika* **10**: 179-198.

EGEA, J.M., X. LLIMONA & M. CASARES (1982) Aportación al conocimiento de la flora liquénica silicícola de la parte culminal de Sierra Nevada. *Collectanea Botanica* **13**: 295-312.

FOLLMANN, G. & S. HUNECK (1972) Mitteilungen über Flechteninhaltsstoffe XCV. Vermischte Flechtenanalysen. *Philippia* **1**: 173-185.

FOX, B.W. & O.W. PURVIS (1992). *Rinodina* (Ach.) Gray (1821). - In: O.W. Purvis, B.J. Coppins, D.L. Hawksworth., P.W. James and D.M. Moore (eds.), In: *The lichen flora of Great Britain and Ireland*: 543-552. Natural History Museum Publications and the British Lichen Society, London.

GIRALT, M. (1994) Key to the corticolous and lignicolous species of the genus *Rinodina* in the Iberian Peninsula and Balearic Islands. *Bulletin de la Société linnéenne de Provence* **45**: 317-326.

GIRALT, M. & M. BARBERO (1995) The saxicolous species of the genus *Rinodina* in the Iberian Peninsula containing atranorin, pannarin and gyrophoric acid. *Mycotaxon* **56**: 45-80.

GIRALT, M. & M. MATZER (1994) The corticolous species of the genus *Rinodina* with biatorine or lecideine apothecia in southern Europe and Macaronesia. *Lichenologist* **26**: 319-332.

GIRALT, M. & H. MAYRHOFER (1994a) Four corticolous species of the genus *Rinodina* (lichenized Ascomycetes, Physciaceae) containing atranorin in southern Europe and adjacent regions. *Nova Hedwigia* **59**: 129-142.

GIRALT, M. & H. MAYRHOFER (1994b) Four corticolous species of the genus *Rinodina* (lichenized Ascomycetes, Physciaceae) with polyspored asci. *Herzogia* **10**: 29-37.

GIRALT, M. & H. MAYRHOFER (1995) Some corticolous and lignicolous species of the genus *Rinodina* (lichenized Ascomycetes, Physciaceae) lacking secondary lichen compounds and vegetative propagules in southern Europe and adjacent regions. *Bibliotheca Lichenologica* **57**: 127-160.

GIRALT, M., M. BARBERO & P.P.G. VAN DEN BOOM (1996) *Rinodina algarvensis,* a new saxicolous, sorediate species from Portugal containing the stictic acid complex. *Lichenologist* **28**: 1-8.

GIRALT, M. , P.P.G. VAN DEN BOOM & M. MATZER (in press) The genus *Rinodina* in The Netherlands, Belgium and Luxemburg. *Mycotaxon.*

GIRALT, M., H. MAYRHOFER & J.W. SHEARD (1995) The corticolous and lignicolous sorediate, blastidiate and isidiate species of the genus *Rinodina* in southern Europe and adjacent regions. *Lichenologist* **27**: 3-24.

GIRALT, M., W. OBERMAYER & H. MAYRHOFER (1993) *Rinodina poeltiana* spec. nova (lichenized Ascomycetes, Physciaceae), a new corticolous blastidiate species from Austria. *Herzogia* **9**: 709-714.

HAFELLNER, J. (1979) *Karschia*, Revision einer Sammelgattung an der Grenze von lichenisierten und nicht lichenisierten Ascomyceten. *Beihefte zur Nova Hedwigia* **62**: 1-248.

HAFELLNER, J. (1993) Über Funde von lichenicolen Pilzen und Flechten im südlichen Norwegen. *Herzogia* **9**: 749-768.

HAFELLNER, J. (1994) Über Funde von lichenicolen Pilzen und Flechten auf Korsika (Frankreich). *Bulletin de la Société linnéenne de Provence* **45**: 219-234.

HAFELLNER, J. (1995) Bemerkenswerte Funde von Flechten und lichenicolen Pilzen auf makaronesischen Inseln III. Einige bisher aud den Kanarischen Inseln übersehene lecanorale Arten. *Linzer biologische Beiträge* **27**: 489-505.

HAWKSWORTH, D.L., P.M. KIRK, B.C. SUTTON & D.N. PEGLER (1995) *Ainsworth & Bisby's Dictionary of the fungi.* 8. ed. C.A.B. Kew, Surrey.

HECKLAU, CH., CH. LEUCKERT & H. MAYRHOFER (1981) Beiträge zur Chemie der Flechtengattung *Rinodina* (Ach.) Gray I. *Herzogia* **5**: 489-498.

HLADUN, N.L., A. GÓMEZ-BOLEA & X. LLIMONA (1986) Els líquens del Montseny .- In: *El Patrimoni natural del Montseny.* Diputació de Barcelona. Servei de Parcs Naturals. Barcelona.

HONEGGER, R. (1978) The ascus apex in lichenized fungi I. The *Lecanora*-, *Peltigera*- and *Teloschistes*-types. *Lichenologist* **10**: 47-67.

HUNECK, S. & G. FOLLMANN (1970) Mitteilungen über Flechteninhaltsstoffe LXXXV. - Zur Phytochemie und Chemotaxonomie der Buelliaceae. *Biochemie und Physiologie der Pflanzen* **161**: 191-214.

HUNECK, S. & J. SCHMIDT (1995) Neue Flechtenanalysen aus verschiedenen Verwandtschaftskreisen.- In: F.J.A. Daniels; M. Schulz and J. Peine (eds.). *Flechten Follmann*: 27-41. Geobotanical and phytotaxonomical study group, Botanical Institute, University of Cologne, Cologne.

LEUCKERT, CH. & H. MAYRHOFER (1984) Beiträge zur Chemie der Flechtengattung *Rinodina* (Ach.) Gray II. *Herzogia* **6**: 373-385.

LÓPEZ DE SILANES, M.E. & R. CARBALLAL (1991) Fragmenta Chorologica Occidentalia, Lichenes, 3101-3151. *Anales del Jardín Botánico de Madrid* **48**: 237-240.

MALME, G. O. (1902) Die Flechten der ersten Regnellschen Expedition II. Die Gattung *Rinodina* (Ach.) Stiz. *Bihang til Kongliga Svenska Vetenskaps-Akademiens Handlingar* **28**: 1-53.

MATZER, M. & H. MAYRHOFER (1994) The saxicolous *Rinodina teichophila* and three closely related species from the southern hemisphere (Physciaceae, lichenized Ascomycetes). *Acta Botanica Fennica* **150**: 109-120.

MATZER, M. & H. MAYRHOFER (1996). Saxicolous species of the genus *Rinodina* (lichenized Ascomycetes, Physciaceae) in southern Africa. *Bothalia* **26:** (in press).

MATZER, M., H. MAYRHOFER, J. SATTLER & PH. CLERC (1994) *Rinodina canariensis* (lichenized Ascomycetes, Physciaceae), a new species parasitic on crustose lichens in Macaronesia and the Mediterranean region. *Nordic Journal of Botany* **14**: 105-111.

MAYRHOFER, H. (1982) Ascosporen und Evolution der Flechtenfamilie Physciaceae. *Journal of the Hattori Botanical Laboratory* **52**: 313-321.

MAYRHOFER, H. (1983) The saxicolous species of *Rinodina* in New Zealand. *Lichenologist* **15**: 267-282.

MAYRHOFER, H. (1984a) Die saxicolen Arten der Flechtengattung *Rinodina* und *Rinodinella* in der Alten Welt. *Journal of the Hattori Botanical Laboratory* **55**: 327-493.

MAYRHOFER, H. (1984b) The saxicolous species of *Dimelaena, Rinodina* and *Rinodinella* in Australia. *Beihefte zur Nova Hedwigia* **79:** 511-536.

MAYRHOFER, H. (1987) *Rinodina*.- In: POELT, J. & P.L. NIMIS (eds), The lichens and lichenicolous fungi of Sardinia (Italy). An annotated list. *Studia Geobotanica* **7,** Suppl. 1**:** 208-215

MAYRHOFER, H. & CH. LEUCKERT (1985) Beiträge zur Chemie der Flechtengattung *Rinodina* (Ach.) Gray III. *Herzogia* **7**: 117-129.

MAYRHOFER, H. & J. POELT (1978) *Rinodinella*, eine neue Gattung der Flechtenfamilie Physciaceae. *Hoppea, Denkschriften der regensburgischen botanischen Gesellschaft* **37**: 89-105.

MAYRHOFER, H. & J. POELT (1979) Die saxicolen Arten der Flechtengattung *Rinodina* in Europa. *Bibliotheca Lichenologica* **12**: 1-186.

MAYRHOFER, H. & J.W. SHEARD (1988) Four notable saxicolous species of the lichenized Ascomycete genus *Rinodina* from the Arctic. *Bryologist* **91**: 106-112.

MAYRHOFER, H., M. MATZER, J. SATTLER & J.M. EGEA (1993) A revision of the Atlantic-Mediterranean *Rinodina beccariana* and related taxa (lichenized Ascomycetes, Physciaceae). *Nova Hedwigia* **57**: 281-304.

MAYRHOFER, H., CH. SCHEIDEGGER & J.W. SHEARD (1990) *Rinodina lecanorina* and *Rinodina luridata,* two closely related species on calciferous rocks. *Bibliotheca Lichenologica* **38**: 335-356.

MAYRHOFER, H., CH. SCHEIDEGGER & J.W. SHEARD (1992) On the taxonomy of five saxicolous species of the genus *Rinodina* (lichenized Ascomycetes). *Nordic Journal of Botany* **12**: 451-459.

NAVARRO-ROSINÉS, P. & N.L. HLADUN (1987) Aportación al conocimiento de los hongos liquenícolas, liquenizados o no, en Catalunya. *Actas del VI Simposio Nacional de Botánica Criptogámica* (Granada): 431-440.

NAVARRO-ROSINÉS, P. & N.L. HLADUN (1990) Flora liquénica de las rocas carbonatadas del Valle de Núria (Pirineos, Cataluña). *Actas del II Coloquio Internacional de Botánica Pirenaico-Cantábrica. Monografías del Instituto Pirenaico de Ecología* **5**: 75-83.

NAVARRO-ROSINÉS, P., C. ROUX & M. GIRALT (in prep.) *Tingitanella* gen. nov., un género para incluir "*Leptosphaeria*" *maheui* R.-G. Werner.

NIMIS, P.L. (1993) *The lichens of Italy. An annotated catalogue.* Monografia XII. Museo Regionale di Scienze Naturali. Torino.

NIMIS, P.L., M. MONTE & M. TRETIACH (1987) Flora e vegetazione lichenica di aree archeologische del Lazio. *Studia Geobotanica* **7**: 3-161.

POELT, J. (1980) *Physcia opuntiella* spec. nov. und die Lebensform der sprossenden Flechten. *Flora* **169:** 23-31.

POELT, J. & W. PETUTSCHNIG (1992) Beiträge zur Kenntnis der Flechtenflora des Himalaya IV. Die Gattungen *Xanthoria* und *Teloschistes,* zugleich Versuch einer Revision der *Xanthoria candelaria*-Gruppe. *Nova Hedwigia* **54:** 1-36.

RAMBOLD, G. & D. TRIEBEL (1992) The inter-lecanoralean associations. *Bibliotheca Lichenologica* **48:** 1-201.

RAMBOLD, G., H. MAYRHOFER & M. MATZER (1994) On the ascus types in the Physciaceae (Lecanorales). *Plant Systematics and Evolution* **192:** 31-40.

RENOBALES, G. & E. BARRENO (1990) Fragmenta Chorologica Occidentalia, Lichenes, 2223-2272. *Anales del Jardín Botánico de Madrid* **47**: 209-214.

RICO, V.J. (1992) Fragmenta chorologica occidentalia, Lichenes, 4013-4049. *Anales del Jardín Botánico de Madrid* **50**: 90-92.

ROPIN, K. & M. MAYRHOFER (1995) Über einige corticole Arten der Gattung *Rinodina* (Physciaceae) mit grauen Epihymenium. *Bibliotheca Lichenologica* **58**: 361-382.

ROWE, J.G. & J.M. EGEA (1987) Líquenes silicícolas de Sierra Morena, I. *Acta Botanica Malacitana* **12**: 59-66.

SAMPAIO, G. (1923) Novos materiais para a liquenologia portuguesa. *Boletin da Sociedade Broteriana,* ser. 2, **2:** 161-182

SANCHO, L.G. (1986) Flora y vegetación liquénica saxícola de los pisos oro- y crioromediterraneo del sistema central español. Doctoral thesis (unpublished data).

SEAWARD, M.R.D. (1983) Lichens of Malaga Province. *Nova Hedwigia* **37:** 325-345.

SCHEIDEGGER, CH. (1993) A revision of saxicolous species of the genus *Buellia* De Not. and formerly included genera in Europe. *Lichenologist* **25:** 315-364.

SHEARD, J.W. (1967) A revision of the lichen genus *Rinodina* (Ach.) Gray in the British Isles. *Lichenologist* **3**: 328-367.

SHEARD, J. W. (1973) *Rinodina interpolata* (Stirt.) Sheard, a new combination in the British and Scandinavian lichen floras. *Lichenologist* **5**: 461-463.

STEINER, M. & H. MAYRHOFER (1987) Flechten aus Afghanistan IV. Die Gattungen *Buellia, Dimelaena* und *Rinodina. Nova Hedwigia* **45**: 315-326.

TERRON, A., M.E. LÓPEZ DE SILANES & J. ETAYO (1992) *Aproximación al catálogo liquénico de Fuentes Carrionas y Sierra de Riaño y su relación con el sustrato.* Departamento Biología Vegetal. Universidad de León. León.

TRIEBEL, D., G. RAMBOLD & T.H. NASH III (1991) On lichenicolous fungi from continental North America. *Mycotaxon* **42**: 263-296.

VEZDA, A. (1994) Lichenes selecti exsiccati editi ab instituto botanico academiae scientiarum Cechoslovacae. Fasc. LXXIX (no. 1951-1975). Pruhonice prope Pragam.

ZOZAYA, C. & J. ETAYO (1994) Líquenes saxícolas y hongos liquenícolas de la Sierra de Ujué (Navarra). *Studia Botanica* **13**: 263-266.

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A NEW SPECIES OF SIMOCYBE FROM NORTH AMERICA

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ABSTRACT

A new species of Simocybe is described from the wood of Populus tremuloides in Alberta, Canada. The relationship of this taxon to other species in the genus is discussed.

Key Words: aspen, Ramicola, Simocybe, Alberta.

INTRODUCTION

A small laterally attached, nearly sessile agaric was found on an aspen log in southern Alberta, Canada. This occurred during field work with a class from Flathead Lakes Biological Station of the University of Montana. The specimens were photographed in place, fresh notes taken, and the two collections noted below represent the preserved specimens. It was determined following microscopic examination to be a Simocybe by the authors. The senior author has extensively studied the species of Simocybe Karsten, also described as Ramicola Velenovsky, from various parts of the world (Horak, 1968, 1979a, 1979b, 1980). The taxon treated here differs from the known species and is described below.

TAXONOMY

Simocybe americana sp. nov. E. Horak and O. K. Miller
Illustrations: Figs. 1-5. Icones: Plate p. 32 as Ramicola, Mushrooms of North America in Color, Bessette et al. 1995.

Pileus 4-12 mm, convexus dein planus, olivaceo-luteus vel argillaco-brunneus, minute velutinus, siccus. Lamellae adnexo-ventricosae, distantes, pallide olivaceae dein argillaceae, fimbriatae. Stipes 0.5-4 x 0.5-1 mm, cylindricus, centralis vel eccentricus, albo-velutinus. Odor acidulosus. Sapor nullus. Caro molis, cremeo-argillacea. Basidiosporae 7-10 x 5-6.5 μm, ovoideae vel pruniformes, pallide brunneae, leves, poro indistincto instructae. Basidia 20-25 x 7-9 μm, 4-sporae. Cheilocystidia 21-57 x 3-7 μm, conspicuae, pedicellato-capitatae, hyalinae. Pileipellis ex cellulis cylindraceis vel subcapitatis palisadam formatibus, 22-38 x 3-5 μm, pigmento brunneo impletae.

Fibulae adsunt. Ad lignum putridum Populi tremuloides. Canada, Alberta, Kananaskis Valley, 20 vii 1989, E. Horak (ZT 4382, holotypus).

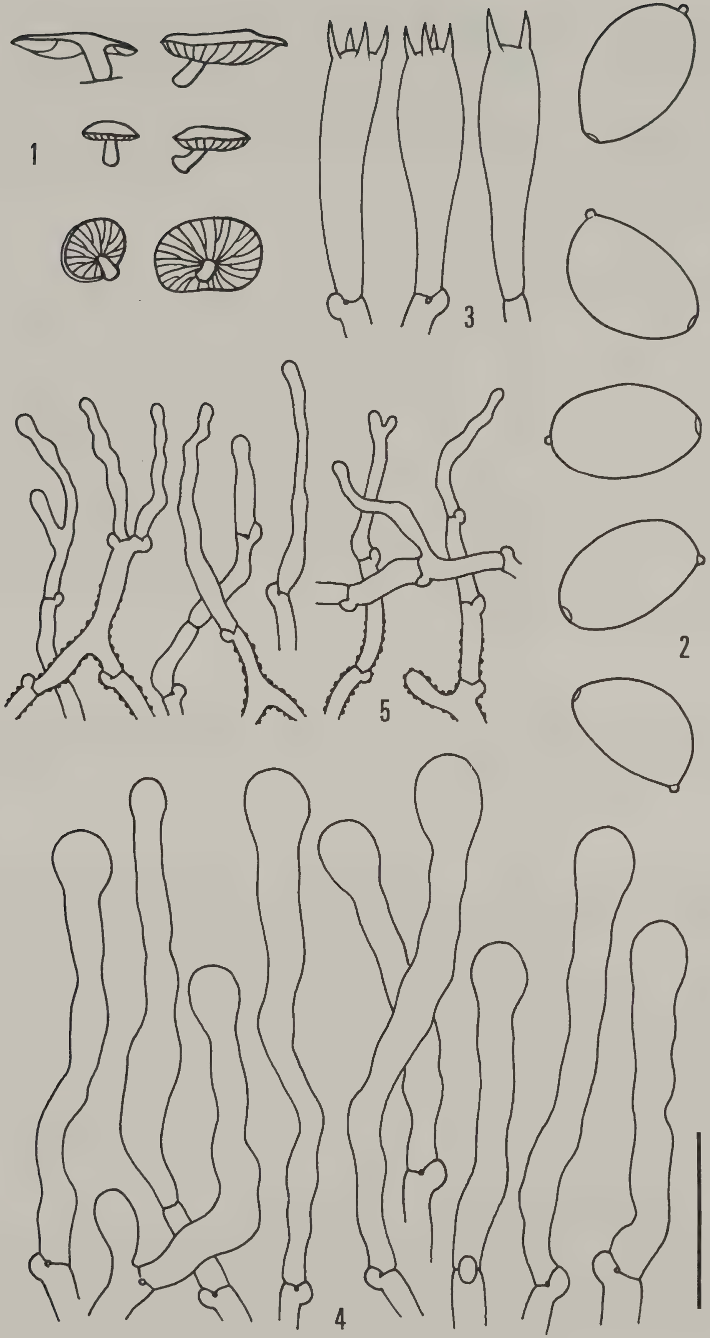
Pileus 4-12 mm broad, convex, flat to broadly umbonate in age, dry, mealy to velvety pruinose, olive-yellow, olive-brown, pale argillaceous to pale brown; margin minutely striate. **Lamellae** deeply adnexed, ventricose, distant (16-20 reach stipe), buff young to olive-yellow in age. **Stipe** 0.5-4 mm long, 0.5-1 mm wide, curved, central or eccentric, equal to clavate, dry, white pruinose over an olivaceous-buff ground color. **Context** soft, cream to buff. **Odor** strongly acidulous. **Taste** not distinctive. **Pileipellis** a trichodermial palisade of hyphal-like, often capitate end cells 22-38 x 3-5 μm thin-walled, often incrusted, brown in 3% KOH, with a basal clamp connection. **Pileitrama** of interwoven, thin-walled hyphae 4.2-10.5 μm diam with a clamp at each septum, hyaline in 3% KOH and Meltzer's solution. **Lamellar trama** interwoven, similar to pileitrama. **Cheilocystidia** very abundant, 21-57 x 3-7 μm, narrowly clavate, hyphal-like with or without capitate apex (-8 μm diam), thin-walled, with a basal clamp connection, hyaline in 3% KOH and Melzer's solution. **Pleurocystidia** similar but scattered, usually near the gill edge. **Basidia** 20-25 x 7-9 μm diam, clavate, thin-walled, 4-spored, hyaline in 3% KOH. **Basidiospores** 7-10 x 5-6.5 μm, pip-shaped to ovoid, thin-walled, pale brown with a very small distinct apical pore. **Spore print** brown.

Habit, habitat, and distribution: gregarious on aspen logs (Populus tremuloides) in the summer, known only from Alberta, Canada.

Material examined: CANADA: Alberta; Kananaskis Valley, north of Racecourse Campground, 4800' elev, 20.VII.1989,
E. Horak, ZT 4382 (holotype) (ZT), C. L. Cripps, July 20, 1989 (VPI).

Observations: The small, convex, pruinose fruiting body with the curved pruinose stipe, on wood, combined with the trichodermial pileipellis and brown, thin-walled spores with a germ pore are characteristics of the genus Simocybe. The long, clamped cystidia, clamped trichodermial cells, 4-spored basidia, and pip-shaped to ovoid spores are a distinctive combination of characteristics which separate S. americana from other species in the genus. It is very possible that it has been misidentified as a Crepidotus or Naucoria and may be much more common in North America than records show to date. In Europe the closely related Ramicola rubi (Berk.) Watl. (Watling, 1988) has been reported on oak and birch. Simocybe is placed in the Crepidotaceae (Imai) Sing., a family characterized by pale brown smooth to verrucose basidiospores often with an apical pore. It is also typified by a pileipellis with a trichodermium, often hymeniform, and pleurotoid, sessile to laterally stipitate, often small fruiting bodies. The majority of the species are decomposers on the wood of Angiosperms and Gymnosperms or on humus (Henson and Knudsen, 1992, Moser, 1983).

Simocybe americana Fig. 1-5. 1. sporocarps. 2. basidiospores. 3. basidia with clamp connection at base. 4. cheilocystidia with clamp connection at base. 5. trichodermium a palisade of hyphal-like to capitate end cells with clamp connections. Fig. 1. bar = 3 cm. Fig. 2. bar = 10μm. Figs. 3-5. bar = 20 μm.



Notes: Simocybe was described by Karsten in 1879 but has not always been accepted as a genus. Recently Simocybe P. Karst. was proposed for and approved as a nomen conservandum with S. centunculus (Fr.:Fr.) P. Karst. as the conserved type. ICBN (Tokyo Code) App. IIIa, p. 163 (Greuter, 1994). Some Simocybe species have been placed in Naucoria and Crepidotus. One of us (EH) has re-examined many of the North American holotypes of Naucoria but none represent the present taxon. In 1992, Dossing, in Nordic Macromycetes, recognized the genus Ramicola Vel. and transferred several species of Simocybe to it. This results in synonymy of the closely related S. rubi (Berk. apud Hooker) Sing. under R. rubi (Berk.) Watl. It has been known as Naucoria effugiens Quél. and is illustrated in Flora Agaricina Danica, plate 125, fig. c., and is closely related to Ramicola haustellaris (Fr.:Fr.) Watl. which was made a new combination by Watling in 1988. Both of the taxa above have also been placed in the genus Crepidotus. Hesler and Smith (1965) placed C. haustellaris (Fr.:Fr.) Kummer in the genus Crepidotus, subgenus Dochmiopus (Pat.) Pilát and described it from Michigan "on hardwood logs." It seems to be closely related to our species but the spores are different and are described as ellipsoid to subovoid with "no germ pore." Kauffman (1918) placed 15 species in the genus Crepidotus and only C. versutus (Pk.) Sacc. is similar to the taxon reported here. Hesler and Smith restudied it and described the spores as "very minutely punctate" without a germ pore and clamp connections in the fruiting body which places it in the subgenus Crepidotus. The color illustration in Bessette et al. (1995) as Ramicola americana adequately illustrates the new taxon and was in press prior to the distribution of ICBN (Tokyo Code) containing Simocybe as a nomen conservandum (Greuter, 1994).

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LITERATURE CITED

Bessette, A. E., O. K. Miller, A. R. Bessette, H. H. Miller. 1995. Mushrooms of North America in color, a field guide companion to Seldom-illustrated fungi. Syracuse Univ. Press, Syracuse, N. Y. 172p.

Greuter, W. 1994. International code of botanical nomenclature. Koeltz Scientific Books, Königstein, Germany. 389p.

Hansen, L., and H. Knudsen. 1992. Nordic macromycetes. Vol. 2. Nordsvamp, Copenhagen. 474p.

Hesler, L. R., and A. H. Smith. 1965. North American species of Crepidotus. Hafner, Inc. New York. 168p.

Horak, E. 1968. Synopsis generum Agaricalium. Beitrage zur Kryptogamenflora der Schweiz 13: 1-741.

_____ 1979a. Two additional species of Simocybe Karsten (Agaricales) from Sabah and Australia. Sydowia 32:123-130.

_____ 1979b. New species of Simocybe Karsten from Papua New Guinea. Ibid 32: 181-184.

_____ 1980. Fungi Agaricini Novazelandiae. X. Simocybe Karsten. New Zealand J. Bot. 18: 189-196.

Kauffman, C. H. 1918. The Agaricaceae of Michigan. Johnson Reprint Corp. New York. 924p.

Moser, M. 1983. Die Röhrling und Blätterpilz. In: Kleine Kryptogammenflora. IIb/2, 5. Aufl. Stuttgart. 533p.

Watling, R. 1988. Some British omphalinoid and pleurotoid agarics. Notes Royal Bot. Gard. Edinb. 45: 549-557.

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A NEW BOLETELLUS FROM CATALONIA (SPAIN)

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ABSTRACT

Boletellus catalaunicus sp. nov. is described and its delimitation from other taxa is discussed. Very likely in the past, the new taxon has been mistaken for other *Boletus* or *Xerocomus spp.* with deep red caps from which it is clearly distinguishable by its pronounced epithelioid pileipellis and its striate spores.

Key words: Basidiomycetes, Boletales, *Boletellus*, taxonomy, Spain.

INTRODUCTION

The most puzzling taxa of boletes are those with red colored caps in the "*Boletus-Boletellus-Xerocomus* complex". Misidentifications, misinterpretations, contradictory generic interpretations, and extensive nomenclatural problems can be tracked down in the literature. *Boletus rubellus* Kromb. or *Xerocomus rubellus* Quél., for example, are not sufficiently delimitated from red forms of *Xerocomus chrysenteron* (Bull.) Quél. Regarding the latter, Smith & Thiers (1971) said: "It is doubtful if any species of bolete has been more frequently misidentified than this one."

In October 1994 Spanish colleagues collected numerous basidiomes of "*B. rubellus*" that grew scattered or in small groups in a mixed hardwood stand near the village of Riells de Montseny (Catalonia, Spain). Studying the variation in morphology of the gathered material they observed that several basidiomes showed unusually vivid red, mat caps with a fine granular appearance of the pileipellis. A year later, a detailed microscopical examination of the dried material revealed striking anatomical features of these vivid red colored specimens: unlike *B. rubellus*, it showed a classical trichodermial pileipellis, the cuticle of the former is formed by an epithelioid or nearly cellular structure; instead of smooth spores, distinctly longitudinal striations of the spores can be seen by using only a light microscope.

We could not find any description or authentical material of a *Boletellus* species with the above mentioned set of features while searching for boletoid species with similar field characters.

METHODS

Microscopic descriptions were made from sections or pieces of tissue taken from dried basidiomes and mounted in 2.5% KOH or *aqua dest.* (in water, pigments did not change their color or dissolve). Spore measurements are given in the form (min.) mean ± standard deviation (max.); sample size (n) > 30. Color notations are from Kornerup & Wanscher (1981). Drawings were made from video prints (Sony Multiscan UP-930).

Scanning Electron Microscopy (SEM): Spores from the hymenophoral tissue were rehydrated with concentrated ammonium hydroxide (28-30%) for 30 min, dehydrated in aqueous ethanol (70%) for 1-1.5 h, and, after fixing for 2 h in pure ethylene glycol dimethyl ether (= 1,2-dimethoxymethane), immersed in pure acetone for at least 2 hours followed by critical point drying and sputtering with gold-palladium. Spores from fresh spore prints were air dried only before sputtering. Micrographs were taken by using a Zeiss DSM-950 SEM.

TAXONOMY

Boletellus catalaunicus R. Pöder, G. Moreno, A. Rocabruna and M. Tabarés *sp. nov.*

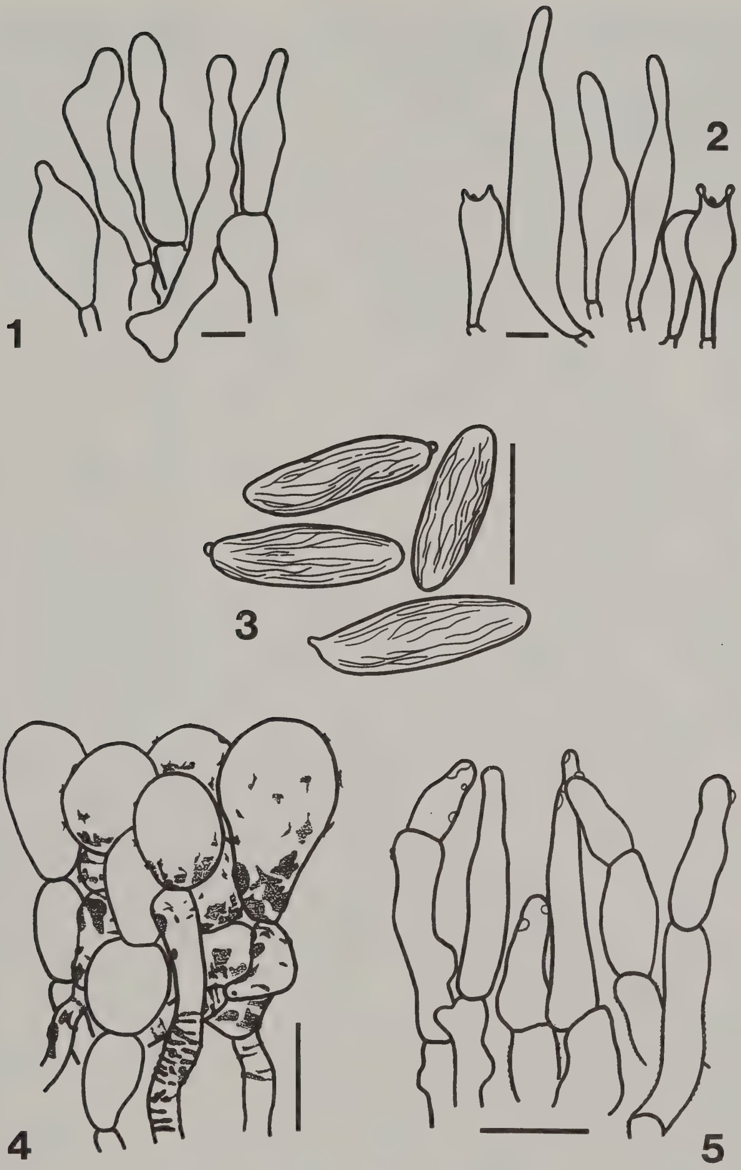
Illustrations: Figs. 1-4 and 6-9.

Pileus 25-45 mm latus, pulvinatus vel late convexus, uniformiter vivide ruber, siccus, aliquantum rugoso-foveolatus, subtiliter granulosus sub lente, ad marginem subtiliter rimosus-areolatus. Contextus luteus. Tubuli 5-8 mm longus, lutei tactu caeruleus; pori usque ad 1 mm lati, lutei tactu caerulei. Stipes 4-6 cm longus, 8-11 mm crassus, solidus, aequalis vel auctus versus basim, subtiliter pruinosus sub lente, sursum poris concolorus, rubellus vel vinosus versus basim, intus luteus tactu caeruleus. Sporae (12.5) 14.5 ± 0.8 (16.3) x (4.5) 5.0 ± 0.3 (5.8) μm, perspicue longistrorsum striatae. Cheilocystidia et Pleurocystidia dispersus, fusoideo-ventricosis. Pileipellis constanter ex cellulis terminalis ovalibus vel subglobosis vel globosis, incrustatis. Habitatio in silvis frondosis mixtis. Holotypus in herbario IB 94/617 conservatum; Riells de Montseny, Catalaunia, Iberia, 1994-10-06, legit A. Rocabruna et M. Tabarès.

Pileus 2.5-4.5 cm broad, pulvinate to broadly convex; surface uneven, somewhat rugose-foveolate (with small, irregular depressions), mat, appearing finely granulose under a lense, dry but slightly butyraceous when moist, uniformly "vivid red" (between 9B8, 10B8, and 11A8) becoming finely radially rimose-areolate at the margin exposing the yellow context; almost no red colors remain in dried specimens. **Context** about 10 mm thick at the pileus center, light yellow to yellow (3A4-3A5). Odor and taste not examined. **Tubes** adnate to slightly decurrent, 5-8 mm deep, pores up to 1 mm, bright yellow (between 3A4 and 3A6) staining bluish when bruised. **Stipe** 4-6 cm long, 8-11 mm thick, equal or slightly enlarged towards the base, minutely pruinose under a lense, concolorous with the pores or somewhat brighter yellow at the apex, reddish to vinaceous-red in the lower third, with some dark brown to nearly blackish spots near the base, staining bluish when injured; mycelium around the base whitish to pale yellowish. Context yellow, with dingy reddish shades in the base, staining bluish.

Basidiospores (12.5) 14.5 ± 0.8 (16.3) x (4.5) 5.0 ± 0.3 (5.8) μm, L/W quotient (2.6) 2.9 ± 0.2 (3.3), volume 190 ± 30 μm^3 (n = 31), wall less than 0.5 μm thick, somewhat inequilateral in profile, apex rounded, with fine but distinct longitudinal, often furcate and somewhat undulate lines or creases which are easily visible in the light microscope (oil immersion); color ochraceous in 2.5% KOH, somewhat darker ochraceous in Melzer's (no amyloid or dextrinoid reaction observed).

Pileipellis distinctly epithelioid consisting of hyphae with 1-3 terminal, strongly inflated, ovate, broadly pyriform to almost spherical cells of equal or increasing diameter. These cells, measuring (24) 36 ± 9 (54) x (21.5) 26.5 ± 5 (48) μm, L/W quotient (1.1) 1.4 ± 0.2 (1.8) in KOH, are formed by subcylindrical, 7-13 (20) μm wide basal hyphae that are narrowing towards the pileus context; both types of hyphal



Figs. 1-5. *Boletellus catalaunicus*. 1. elements of the chaulohymenium. 2. basidia and cheilocystidia. 3. basidiospores. Scale bars = 10 μm. 4. elements of the epithelioid pileipellis (incrustations not fully shown). 5. elements of the trichodermial pileipellis of *Boletus (Xerocomus) rubellus* (IB 95/1010) from the type location of *B. catalaunicus*. Scale bars = 30 μm.

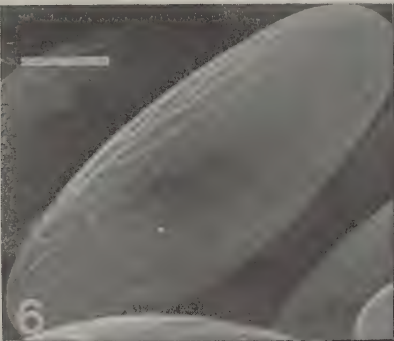
elements are often heavily incrusted. Incrustations and cell content, the former sometimes appearing as plates of a broken outer wall-layer, are light to dark ochraceous in KOH as well as in Melzer's but mixed with reddish shades in water. Hyphae of the pileus context hyaline to pale yellowish, smooth or with finely granulated walls.

Basidia mainly 4-spored, broadly clavate, 30-40(45) x 10-13 μm, some with yellow content in KOH and Melzer's. **Cheilocystidia** scattered, 55-85 μm long, maximum width 9-14 μm, fusoid-ventricose, thin-walled, smooth, content hyaline to yellow. **Pleurocystidia** rare; size and shape similar to cheilocystidia. **Tube trama** of subparallel to slightly diverging, 5-15 μm wide hyphae; mediostratum indistinct, yellowish, hyphae with finely granulated walls; lateral hyphae less pigmented, nearly hyaline in KOH. **Caulohymenium** present over the whole stipe mainly consisting of basidioliform cells that are intermixed with both basidia and polymorphic, cystidia-like elements; extra- and intracellular pigments in 2.5% KOH vivid orange-brown to ochraceous in the lower part of the stipe, pale yellowish above. Light refracting, golden hyphal elements in all tissues abundant to scatterd. **Clamp connections** absent in all tissues which are non-amyloid.

Habitat: terrestrial, solitary to scattered, together with *B. rubellus*, in autumn among litter on sandy soil under mixed hardwoods *(Quercus ilex* L., *Castanea sativa* Miller, *Fagus sylvatica* L., *Alnus glutinosa* (L.) Gärtner, *Populus sp.*, and *Fraxinus sp.*).

Material examined: ***Boletellus catalaunicus*** R. Pöder, G. Moreno, A. Rocabruna & M. Tabarés: Among litter on sandy soil under mixed hardwoods, Riells de Montseny (Catalonia, Spain), *leg.* A. Rocabruna & M. Tabarés, 1994-10-06, IB 94/617 (holotype); ***Boletus rubellus*** Kromb.: Among litter on sandy soil under mixed hardwoods, Riells de Montseny (Catalonia, Spain), *leg.* R. Pöder, 1995-10-17, IB 95/1010; *Ibidem*: Under *Pinus* and *Quercus*, Mosqueroles (Barcelona, Spain), *leg.* A. Rocabruna, 1995-10-15, IB 95/1011; *Ibidem*: Under *Pinus* and *Quercus*, St. Grau (Girona, Spain), *leg.* R. Pöder, 1995-10-16, IB 95/1012; ***Xerocomus chrysenteron*** (Bull.) Quél: Under mixed hardwoods, Riells de Montseny (Catalonia, Spain), *leg. et det.* R. Pöder, 1995-10-17, IB 95/1013; *Ibidem*: Under oaks and pines, Olzinelles (Barcelona, Spain); ***Boletellus pseudochrysenteroides*** A. H. Smith & Thiers: Under beech and other hardwoods, Sharon Hollow, near Manchester, Washtenaw Co. (Michigan, USA), *leg.* A.H. Smith, 1961-09-15, Herb. Univ. Mich. 64264 (holotype); ***Boletellus pruinatus*** (Fr. & Hök.) Klofac & Krisai: Under spruce and beech, near Knappenberg (Kärnten, Austria), leg. et det. R. Pöder, H. Ladurner & M. Kirchmair, 1995-10-08, IB 95/970; *Ibidem*: Under spruce and fir, Roncegno, Cinque Valli (Trentino, Italy), *leg.* A. Zucharelli & A. Hausknecht, 1991-09-16, det. W. Klofac, WU 10130; *Ibidem*: Under beech and birch, Hainfeld, Michelbach (Niederösterreich, Austria), *leg. et det.* W. Klofac, 1990-10-07, WU 8939.

Figs. 6-13. SEM micrographs of basidiospores. 6-9. *Boletellus catalaunicus*. 10. *Boletellus pruinatus* (IB 95/970). 11. *Boletus (Xerocomus) rubellus* (IB 95/1010), note smooth spore surcace. 12-13. *Boletellus pseudochrysenteroides* (holotype). Scale bars 2 μm; bar in Fig. 9. = 1 μm.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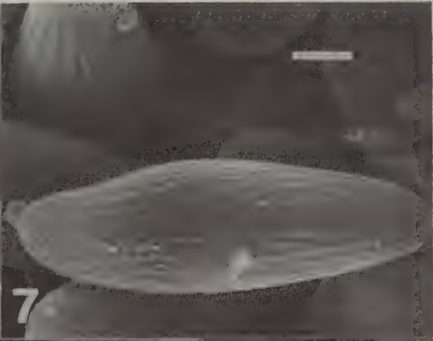
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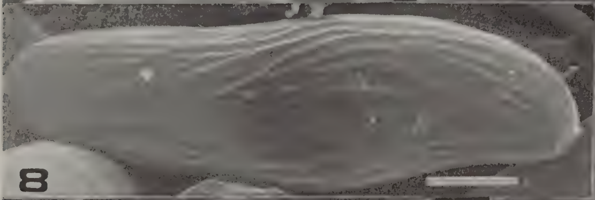
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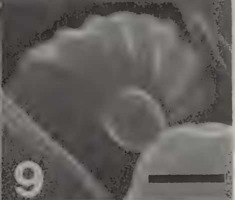
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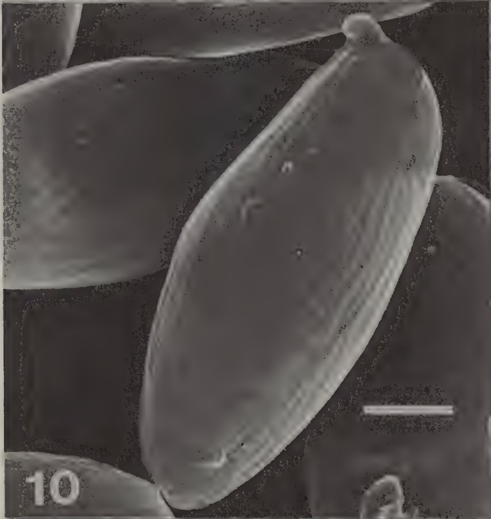
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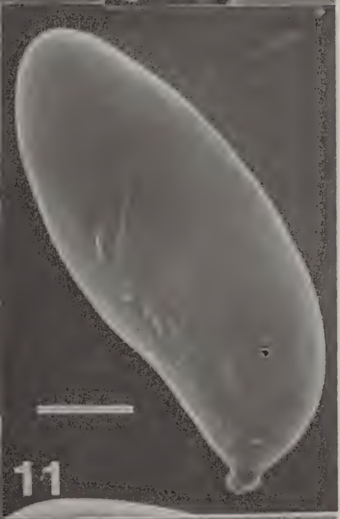
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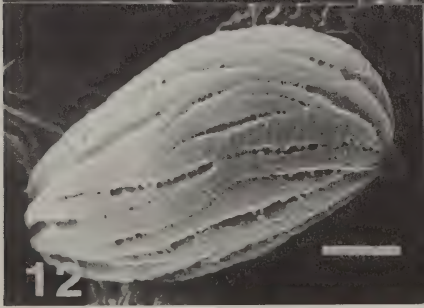
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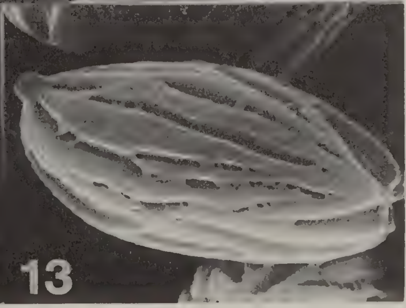
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Observations: The homogeneously vivid red colored pileus, the pronounced epthelioid structure of the pileipellis, and the distinctly striated spores features this species among others with similar field characters. *Boletus (Xerocomus) rubellus* which shares the same habitat with *B. catalaunicus* is macroscopically very similar to the latter but it has completely smooth spores (Fig. 11) and a trichodermial pileipellis of cylindrical, relatively slender, nearly smooth-walled cells with obtuse to cystidia-like terminal elements (Fig. 5).

The "dark rose-red" pileipellis of *Boletellus pseudochrysenteroides* Smith & Thiers is a trichodermium with tubular to clavate, smooth-walled, 8-15 μm wide terminal cells; its spores are relatively short (11-14 μm) and up to 8 μm broad showing a strange ornamentation (Figs. 12-13) of sublongitudinal, somewhat interveined ridges "with an apical break in the outer wall in the form of a slit" (Smith & Thiers 1971).

Another taxon that reminds one of members of the "*B. rubellus* group" (Singer 1977; Klofac & Krisai-Greilhuber 1992) is *Boletellus obscureococcineus* (v. Hoehn.) Singer. This species was originally described from Java and should be easily distinguishable from *B. catalaunicus* by its relatively large spores (15.5-21 x 7.5-8 μm).

The key characters of *B. catalaunicus* do not suggest its interpretation as a red form of *X. chrysenteron* (Bull.) Quél. or of *B. pruinatus* (Fr. & Hök) Klofac & Krisai-Greilhuber. The trichodermial cutis structure of the latter two is distinctly different from that of *B. catalaunicus*. The spores of *X. chrysenteron* are smooth, the spore ornamentation of the predominantly dark brown to blackish brown colored *B. pruinatus* is less pronounced when seen under oil immersion or in SEM (Fig. 10).

Oolbekkink (1991) reports the occurrence of *Boletus fraternus* Peck in the Netherlands which is an another small bolete with a deep red cap. His description of two records from 1983 largely agrees with ours of *B. catalaunicus*. The cap is red to deep red; pileipellis epithelioid with inflated terminal and subterminal cells which are up to 45 μm broad but "without or with scarce incrustations"; spores "13.5 ± 1.1 x 4.9 ± 0.5 μm, Q = 2.8 ± 0.2, with faint to distinct striae with SEM". We agree with Klofac & Krisai-Greilhuber (1992) who carefully examined six collections of *B. fraternus* from North America (see also the comments of Smith & Thiers (1971) on the type collection) that Oolbekkink's identification is based on a misinterpretation of *B. fraternus*. The spores of the latter are smooth and the pileus cuticle is formed by "a weak trichodermium of hyphae 7-15 μm wide, the elements mostly of short cells often inflated, the walls thin and essentially smooth, cells readily collapsing, end-cells bullet-shaped or beaked" (Smith & Thiers, 1971). According to Klofac & Krisai-Greilhuber (1992) "sphaerocytes" can be found only occasionally, especially at the basal area of the trichodermium.

In summary, *B. catalaunicus* differs sharply in its microscopical features from other boletoid taxa with similar field characters. It represents, besides *B. pruinatus*, the second species of the genus *Boletellus* that has been described from Europe.

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LITERATURE CITED

Klofac, W. and I. Krisai-Greilhuber. 1992. *Xerocomus chrysenteron* und ähnlich aussehende Röhrlinge. Öst. Zeitschr. f. Pilzk. 1: 19-59.

Kornerup, A. & J. H. Wanscher. 1981. Methuen handbook of color. Eyre Methuen, London. 252 p.

Oolbekking, G. T. 1991. The taxonomic value of the ornamentation of spores in 'the Xerocomus-group' of Boletus. *Persoonia* 14(3): 245-273.

Singer, R. 1977. The Boletineae of Florida with notes on extralimital species. Bibliotheca Mycologica. Vol 58. J. Cramer, Vaduz. 567 p.

Smith, A. H. & H. D. Thiers. 1971. The Boletes of Michigan. The University of Michigan Press, Ann Arbor. 428 p.

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DERMOCYBE CISTOADELPHA, A NEW SPECIES IN THE SECTION *SANGUINEAE* FROM SPAIN

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ABSTRACT

Dermocybe cistoadelpha sp. nov. is described and discussed in relation to related species in the section *Sanguineae*. Macroscopical, microscopical, ecological and chemical characteristics permit a clear distinction of the new taxon from other taxa.

Key words: Agaricales, *Dermocybe*, taxonomy, chemotaxonomy, *Cistus*, Spain.

INTRODUCTION

A new *Dermocybe* was found in Extremadura or more precisely the Natural Park of the Villuercas, Cáceres, Spain. The type locality is composed of forests of *Quercus ilex* subsp. *ballota* (Desf.) Samp. and *Q. suber* L. as well as large areas covered only by *Cistus ladanifer* L. on acid soils. This species of *Cistus* is locally known as "jara". These pure stands of *Cistus* are of special interest to mycologists from an ecological and mycorrhizal point of view.

METHODS

Microscopic descriptions were made from sections or pieces of tissue taken from dried basidiomes and mounted in 2.5% KOH. A Nikon Labophot microscope with an automatic photographic system was used for light microscopy (LM). Videoprints of spores taken from the cortina were used for spore measurements (sample size for each collection > 30). Measurements are given in the form (min.) mean +- standard deviation (max.). Color notations are from Kornerup & Wanscher (1981).

Thin layer chromatography (TLC) using five different solvent systems on silica gel DC plates was carried out according to Keller & Ammirati (1983). Pigment patterns were examined in daylight, under UV light (365 nm), and after spraying with 5% KOH in methanol.

Scanning Electron Microscopy (SEM): Spores from the cortina were rehydrated with concentrated ammonium hydroxide (28-30%) for 30 min, dehydrated in aqueous ethanol (70%) for 1-1.5 h, and, after fixing for 2 h in pure ethylene glycol dimethyl ether (= 1,2-dimethoxymethane), immersed in pure acetone for at least 2 hours followed by critical point drying and sputtering with gold-palladium. Micrographs were taken by using a Zeiss DSM-950 SEM.

TAXONOMY

Dermocybe cistoadelpha sp. nov. G. Moreno, R. Pöder, M. Kirchmair, F. Esteve-Raventós & M. Heykoop

Illustrations: Figs. 1-11.

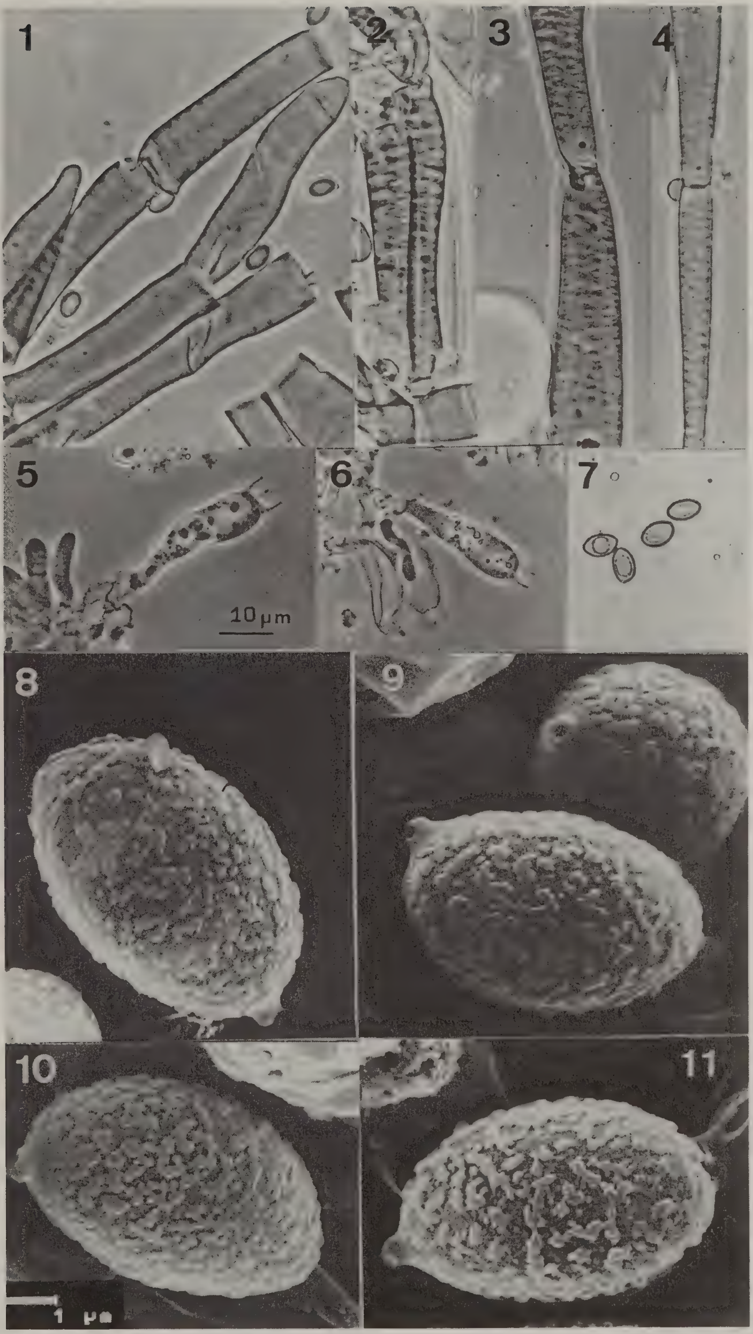
Pileo 20-55 mm lato, campanulato vel convexo vel applanato-convexo, mamilla centrali obtusa vel conica, margine decurvato vel plano. Epicute rubra. Lamellis adnatis, moderate confertis, tenuis latibusque, sanguineis; lamellulis intermixtis. Stipite 30-60 x 3-8 mm longo, solido vel fistuloso versus basim, flavido in tertio superiore, ab basim rubro vel vinoso. Cortina vinosa, abundanti. Carne vinoso-purpurea sub cuticula; in stipite flavida vel albo-flavida. Sapore acidulo. Odore inconspicuo. Basidiosporis (6.4) 7.1 ± 0.4 (8.1) x (4.2) 4.7 ± 0.3 (5.3) μm, ochraceis in solutione potassico, ellipsoideis vel subamygdaliformibus, laeve verrucosis. Basidiis tetrasporis, 27-35 x 6-8 μm, claviformibus. Cheilocystidiis indistinctis, basidioliformibus, dispersis. Pileipelle ex hyphis cylindricis, 8-15 μm latis, fibulatis; pigmento incrustante minuto, purpureo vel violaceo in solutione potassico. Habitatio ad humus sub *Cistus ladanifer* L. in solo granitico. Holotypus in herbario AH 18359 conservatum; Pto. Cañamero, Villuercas, Hispania, 1994-11-22, legit V. González, G. Moreno, A. Altés et R. Galán.

Pileus 20-55 mm broad, campanulate to convex or plano-convex, with a central conical or obtuse umbo, more or less reddish purple (11B8-11B7 "geranium red" to 12B7-12B6 "bluish red"), slightly fibrillose under the lens, margin inflexed to straight. **Lamellae** thin (0.1 mm) and 4-5 mm broad, moderately crowded, adnate to narrowly adnate, blood red, with lamellulae. **Stipe** 30-60 x 3-8 mm, cylindrical, sinuous to curved, at the base solid to fistulose, reddish purple (between 11B8-11B7 and 12B7-12B6) with yellowish tints on the upper half (between 2A8 "vivid yellow" and 3A6 "yellow"). **Cortina** abundant, concolorous with the cap. Context wine tinted purple under the cuticle (12A5 "rose" or darker), "yellowish white" to "pale yellow" (1A3-1A2 and 2A5-2A6) under the stipe cortex. Taste acidulous. Smell none.

Basidiospores (6.4) 7.1 ± 0.4 (8.1) x (4.2) 4.7 ± 0.3 (5.3) μm; L/W (1.3) 1.5 ± 0.1 (1.7); average volume 82.3 ± 12.5 μm^3; in face view broadly elliptical, in profile subamygdaliform, ochraceous in 2.5% KOH, slightly verruculose. Under the S.E.M., the spores show an ornamentation formed by flat, irregular, sometimes subreticulate crests as well as isolated verrucae. **Basidia** 27-35 x 6-8 μm, clavate, 4-spored, hyaline or with purplish content. **Pleurocystidia** absent. **Cheilocystidia** inconspicuous, basidioliform, scattered. **Pileipellis** formed by interwoven, more or less radially arranged cylindrical hyphae, 8-15 μm wide, with finely encrusting, and intracellular (plasmatic) pigments; the latter turns purplish to deep violet in 2.5% KOH or 5% NH_4OH. No interhyphal pigment deposits were observed in KOH. **Clamp connections** of the normal type present.

Habitat: scattered, gregarious, often in caespitose clusters on acid, sandy soil in humus of *Cistus ladanifer* L. brushwoods.

Figs. 1-11. *Dermocybe cistoadelpha* (holotype). 1-4. clamped, pigmented hyphae of the pileipellis. 5-6. basidia. 7. basidiospores. 8-11. SEM micrographs of basidiospores.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Material studied: ***Dermocybe cistoadelpha*** Moreno, Pöder, Kirchmair, Esteve-Raventós & Heykoop: From acid soil in humus of *Cistus ladanifer* L., Pto. Cañamero, Villuercas (España), *leg*. V. González, G. Moreno, A. Altés & R. Galán, 1994-11-22, AH 18359 (holotype), *Isotypus* in IB 94/606; ***Dermocybe sanguinea*** (Wulf. in Jacq.: Fr.) S. F. Gray: Ocean City, Grays Bay Co., Washington (USA), *leg*. G. Keller, H. Dilitz & J. Rodgers, 1980-11-25, IB 80/110; *Ibidem*, Under *Picea abies* and *Abies alba*, Cinque Valli, Roncegno, Val Sugana (Trentino, Italy), *leg. et det*. M. Moser, 1986-09-19, IB 86/251; ***Dermocybe sanguinea*** (Wulf. in Jacq.: Fr.) S. F. Gray **var.** ***vitiosa*** Moser: Under coniferous trees, Femsjö, Smoland (Sweden), *leg. et det*. M. Moser, 1974-08-16, IB 74/117 (holotype); ***Dermocybe phoenicea*** (Bull.: Mre.) Moser: Under *Picea abies* and *Pinus sylvestris* between mosses, Patscheralm, Tirol (Austria), *leg. et det*. M. Moser, 1994-09-27, IB 94/311; ***Dermocybe phoenicea*** (Bull.: Mre.) Moser **var.** ***occidentalis*** (Smith) Ammirati: Under *Pseudotsuga sp*. and *Larix sp*., Clear Creek Camp Ground, Wasco Co., Mt. Hood area, Oregon (USA), *leg. et det*. M. Moser, 1995-10-28, IB 95/437; *Ibidem*, under fir and pine, Crescent City, California (USA), *leg. et det*. A. H. Smith, 1937-11-22, IB 8997; ***Dermocybe semisanguinea*** (Fr.: Fr.) Moser: Under *Picea abies* and *Pinus sylvestris* between mosses, Strader Wald near Imst, Tirol (Austria), *leg. et det*. M. Moser, 1965-09-15, IB 65/111; ***Dermocybe marylandensis*** Ammirati: In mixed hardwoods or with Pinus and hardwoods together, Devil's Mill Hopper, near Gainesville, Florida (USA), J. F. Ammirati, WTU 7936 (holotype).

Observations: Macroscopically *Dermocybe cistoadelpha* is characterized by its deep red pileus, the blood red gills, the stipe which is yellowish at the apex and densely covered by deep red fibrils on the lower two thirds. Its most striking feature is the whitish to pale yellowish context throughout the stipe; purplish red colorations appear only in the pileus context beneath the cuticle. The spore shape is significantly less ellongated (Table 1) than that of related species in the section *Sanguineae*.

The pigment pattern of *D. cistoadelpha* (Table 2) is characterized by the presence of dermocybin, large amounts of dermolutein, and the absence of emodin and dermorubin. The total pigment pattern was easily distinguishable from that of all other investigated species due to the presence of specific but unidentified pigments, and quantitative and qualitative differences in known pigments.

A partially whitish stipe context was also found in *Dermocybe sanguinea* var. *vitiosa*, originally described by Moser (1976) from Sweden "under coniferous trees": a color slide of the type collection (IB 74/117) shows a pinkish red stipe context or cortical layer leaving a small but distinct whitish core. The pigment pattern (= pigments identified in this study) is somewhat similar to that of *D. cistophila* except for the presence of dermorubin and the distinctly lower amounts of dermolutein. The spores of the type material are significantly smaller and more elliptical than those of *D. cistoadelpha* (Table 1).

Three additional species, namely *Dermocybe phoenicea* (Bull.: Mre.) Moser and its variety *occidentalis* (Smith) Ammirati (Type II), *Dermocybe semisanguinea* (Fr.: Fr.) Moser, and *Dermocybe marylandensis* Ammirati belong more or less to the same pigmentation type as described above: they produce no emodine or emodine-glycoside but do produce remarkable amounts of dermocybin and its glycoside (see also Steglich & Austel, 1969; Keller, 1982; Keller & Ammirati, 1983; Liu *et al*., 1995). All of these species are separable from *D. cistoadelpha* by different morphological and ecological characters (Table 1).

Our studies revealed the existence of two chemically different "forms" of *Dermocybe phoenicea* (Bull.: Mre.) Moser var. *occidentalis* (Smith) Ammirati which are morphologically very similar, an issue already adressed by Ammirati (1989): one form (indicated as Type I in Table 2; Smith 8997; California, USA) produces large amounts of emodine and emodine-glycoside whereas the pigment pattern of "Type II" (IB 95/437; Oregon, USA) without emodine was nearly identical with that of *D. semisanguinea* (IB 65/111; Austria). Since the type material has not been chemically

Table 1. Differential characters of non-emodin producing *Dermocybe spp*. in the section *Sanguineae*. Macroscopical data were taken from original descriptions. Color notations in parenthesis refer to Ridgway (1912).

Characters	*D. cistoadelpha* Isotype IB 94/606	*D. sanguinea* var. *vitiosa* Holotype IB 74/117	*D. phoenicea* var. *phoenicea* IB 94/311	*D. phoenicea* var. *occidentalis* A. H. Smith 8997	*D. marylandensis* Holotype WTU 7936	*D. semisanguinea* IB 65/111
Habitat	mediterranean, among *Cistus sp*.	coniferous wood among mosses	coniferous wood among mosses	coniferous wood	mixed hardwoods or with *Pinus* and hardwoods	coniferous wood among mosses
Colors						
Pileus	dark red to rich red	brownish red	reddish brown	dark red to rich red (Ox-blood Red to Garnet Brown)	brownish red to brownish orange	yellow-brown to olive-brown
Lamellae	blood red	blood red with a brownish tinge	blood red	deep purplish red (Bordeaux)	brownish red	blood red
Stipe	deep red by veil, whitish to pale yellow in the upper third	pinkish red, paler red to withish at the apex with pinkish red fibrils	yellow to dull yellow with zones of red fibrils	yellow to dull yellow (Mustard to Honey Yellow) with yellowish fibrils	brownish red to pinkish red, somtimes with dark red fibrils	yellowish to chrome yellow with ochraceous to brownish fibrils
Basal mycelium	deep red	pinkish	pale ochraceous-orange or tinged reddish	ochraceous or tinged reddish to vinaceous red	pale vinaceous pink to pinkish or pinkish buff	reddish orange
Stipe context	dull whitish to pale yellow	pinkish red with whitish core	pale sordid reddish to ochraceous, yellowish under cortex	light yellowish olive (Old Gold), sordid brownish in age	pale reddish faded to pinkish white	yellow to dull golden yellow

Table 1 continued

Characters	*D. cistoadelpha* Isotype IB 94/606	*D. sanguinea* var. *vitiosa* Holotype IB 74/117	*D. phoenicea* var. *phoenicea* IB 94/311	*D. phoenicea* var. *occidentalis* A. H. Smith 8997	*D. marylandensis* Holotype WTU 7936	*D. semisanguinea* IB 65/111
Cortina	deep red	pinkish red	purplish red	dull yellow (Chamois) to light ochraceous	pinkish red or concolorous with the stipe apex	yellowish or tinged olivaceous
UV-reaction of stipe (dried basidiomes)	dark to very dark red	no data	dark to very dark red	bright yellow to orange-yellow	dark to very dark red	bright yellow to orange-yellow
Spores						
Length (L) (µm)	(6,3) **7,1 ± 0,4** (8,2)	(5,6) **6,4 ± 0,5** (7,8)	(6,9) **7,3 ± 0,3** (8,2)	(6,9) **7,1 ± 0,3** (8,2)	(6,9) **7,7 ± 0,5** (9,0)	(6,9) **7,5 ± 0,4** (8,6)
Width (W) (µm)	(4,2) **4,7 ± 0,3** (5,3)	(3,4) **3,9 ± 0,3** (4,3)	(3,9) **4,4 ± 0,2** (4,7)	(3,9) **4,5 ± 0,3** (5,2)	(3,9) **4,3 ± 0,2** (4,7)	(4,3) **4,8 ± 0,2** (5,2)
L/W	1,5 ± 0,1	1,7 ± 0,2	1,7 ± 0,1	1,6 ± 0,1	1,8 ± 0,1	1,6 ± 0,1
Volume (μm^3)	82,3 ± 12,5	51,2 ± 9,5	72,6 ± 10,0	74,0 ± 9,9	73,6 ± 9,4	90,7 ± 9,9

Table 2. Pattern of identified pigments in *Dermocybe cistoadelpha* compared with that of other investigated species of the section *Sanguineae*. Symboles: * data taken from Liu & al. (1995), +,++,+++,++++ indicate relative intensity, - pigment not detected, (+) traces of pigment detectable.

Pigment	*Dermocybe. cistoadelpha*	*Dermocybe sanguinea* var. *sanguinea*	*Dermocybe. sanguinea* var. *vitiosa* *	*Dermocybe phoenicea* var. *phoenicea*	*Dermocybe phoenicea* var. *occidentalis* Type I	*Dermocybe phoenicea* var. *occidentalis* Type II	*Dermocybe marylandensis*	*Dermocybe semisanguinea*
Emodin	-	++++	-	-	++++	-	-	-
Dermocybin	+++	++++	++	++	+++	+++	+++	+++
Endocrocin	+	-	(+)	(+)	(+)	(+)	(+)	(+)
Dermolutein	++++	+	++	++	++	++	++	++
Dermorubin	-	++	+	+	+	+	+	+
Emodin-glycosid	-	+++	-	-	+++	-	-	-
Dermocybin-glycosid	++	+++	+++	+++	+++	++	++	++

analyzed so far (pers. comm. Ammirati, 1996) it is still unclear whether or not one of the two forms represents a new taxon. In order to distinguish the two forms it might be helpful to know that the UV reaction (366 nm) of dried basidiomes of Type I (with emodine) is more or less negative (dark to very dark red in cap, gills, and stipe) while Type II (without emodine) develops a yellow, golden yellow to bright yellow fluorescence all over the stipe.

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LITERATURE CITED

Ammirati, J. F. 1989. *Dermocybe*, *subgenus Dermocybe*, section *Sanguineae* in Northern California. Mycotaxon 34: 21-36.

Keller, G. 1982. Pigmentationsuntersuchungen bei europäischen Arten aus der Gattung *Dermocybe* (Fr.) Wünsche. Sydowia 35: 110-126.

Keller, G. and J. F. Ammirati. 1983. Chemotaxonomic significance of anthraquinone derivatives in North American species of *Dermocybe*, section *Sanguineae*. Mycotaxon 18: 357-377.

Kornerup, A. and J. H. Wanscher. 1981. Methuen handbook of colour. Eyre Methuen London.

Liu, Y, S. O. Rogers, J. F. Ammirati & G. Keller. 1995. *Dermocybe*, section *Sanguineae*: A look at species relationships within the sanguinea complex. Sydowia Beihefte 10: 142-154.

Moser, M. 1976. Die Gattung *Dermocybe* (Fr.) Wünsche (Die Hautköpfe). Schweiz. Zeitschr. f. Pilzk. 54(10): 145-150.

Ridgway, R. 1912. Colour Standards and Colour Nomenclature. Washington D.C.

Steglich, W. and V. Austel. 1969. Anthrachinonpigmente aus *Dermocybe sanguinea* (Wulf. ex Fr.) Wünsche und *Dermocybe semisanguinea* (Fr.) Mos. Chem. Ber. 102: 4104-4118.

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FUNGAL AND LICHENOLOGICAL TYPES IN THE UNIVERSITY HERBARIUM, UNIVERSITY OF CALIFORNIA AT BERKELEY (UC)-- A PARTIAL LISTING

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ABSTRACT

Fungal and lichenological type collections deposited at UC are listed, representing 321 taxa (128 holotypes, 16 lectotypes, two neotypes, and 175 isotypes, including isolectotypes and isoneotypes). This list includes about one-third of the isotypes and most holotypes, lectotypes, and neotypes in UC. A brief history of the UC fungal and lichen collection is given, together with host and collection data. Included are annotations correcting mistakes in protologues or monographic treatments involving a number of the specimens. Nineteen taxa are lectotypified.

INTRODUCTION

In 1872, four years after the University of California was founded, a natural history museum was established, which included a small herbarium of vascular plants. The first 12 fungi were deposited in 1892 by Walter C. Blasdale (Cryptogamic Botany assistant), followed by 25 fungi from Thomas J. Burrill, Champaign, Illinois, in 1892 and 94 lichens from Clara E. Cummings, Wellesley, Massachusetts in 1893. Later acquisitions accumulated gradually with the addition of various specimens sent to the University as gifts or exchange. Currently, the mycological herbarium consists of approximately 170,000 accessioned specimens and several nearly intact exsiccatae including Fries's Scleromyceti Sueciae (Decades 1-30, 1819-1822), Krieger's Fungi Saxonici Exsiccati, and Ellis's & Everhart's Fungi Columbiani, Cent. 1-50 (15-50 distributed by Elam Bartholomew). As a result of an intensive exchange program, the holdings also include a large number of northern European microfungi, specimens received from Franz Petrak (European and exotic), and South American and Mexican microfungi (especially Uredinales from the Edward W. D. Holway collection, University of Minnesota). There are also large numbers of Philippine fungi received from Mary S. Clemens, Elmer D. Merrill, and Henry S. Yates.

Major collectors of Californian fungi deposited at UC include Walter C. Blasdale, Lee Bonar, William Bridge Cooke, Nathaniel L. Gardner, Thomas T. McCabe, Vera P. Mentzer Miller, Elizabeth E. Morse, Harold E. Parks, Clarence R. Quick, William A. Setchell, and Joseph P. Tracy. An index to Californian fungi and host plants was established by Lee Bonar and has been maintained by staff members in a card file, in loose-leaf notebooks, and to a limited extent in computerized records. Major collectors of Californian lichens in the holdings include Albert W. C. T. Herre, Isabelle Tavares, William A. Weber, and T. Elliot Weier.

Many of the holotypes were deposited in the herbarium by Lee Bonar, Helen M. Gilkey, Elizabeth E. Morse, and William A. Setchell, as well as by Edward E. Butler, Donald G. Cooney, Ralph Emerson, and Annette W. Ramaley. A number of the isotypes were received as gifts or exchange from Richard K. Benjamin, Rancho Santa Ana Botanic Garden; Henry C. Greene, University of Wisconsin; Donald T. Kowalski, Chico State University; and William A. Weber, University of Colorado. Other sources of isotypes included the fungal collections of Harold E. Parks and Walter C. Blasdale's herbarium of Uredinales, both of which were deposited in UC.

Although a number of important specimens are in the holdings, the fungal collections have not been used extensively nor recognized adequately because UC has not always had an active systematic mycology program. To facilitate taxonomic research, a list of type specimens housed at UC with references to the appropriate literature is presented here.

This catalogue includes 128 holotypes, 16 lectotypes, two neotypes, and 175 isotypes (only one accession number for a taxon was counted). A survey of paratypes has not yet been made, although they were included for one taxon.

Taxa are arranged alphabetically, with nomenclatural synonyms and illegitimate homonyms, etc., added as cross-references to facilitate the use of the list. Following the basionym are the original reference, type status, UC accession number, and collection data, together with pertinent notes. Only the county and state are indicated for collections from the United States; for other countries, states, provinces, districts, and some counties have been added when not in the protologue. In a few instances, the collector is not indicated and the date is not given. A list of abbreviations used throughout this list is provided following this introduction.

Acronyms used for herbaria are from Holmgren et al., 1990, or are explained here. Brummitt and Powell, 1992, were consulted for the abbreviation of the names of authors; Lawrence et al., 1968, and Bridson and Smith, 1991, were used for journal abbreviations. See also Greuter, 1988.

The following taxa are lectotypified here: *Comatricha anastomosans* Kowalski (CHSC), *Diacheopsis effusa* Kowalski (UC), *D. serpula* Kowalski (CHSC), *Didymium disciforme* Kowalski & T. N. Lakh. (CHSC), *Elasmomyces russuloides* Setch. (UC), *Exosporina fawcettii* E. E. Wilson (UC), *Gloeosporium limetticola* R. E. Clausen (UC), *Guignardia alaskana* M. Reed (UC), *G. irritans* Setch. & Estee (UC), *Lepidoderma aggregatum* Kowalski (CHSC), *L. didermoides* Kowalski (CHSC), *Licea deplanata* Kowalski (CHSC), *L. hepatica* Kowalski (CHSC), *Omphalia tralucida* Bliss (UC), *Phyllosticta lupini* Bonar (UC), *Squamuloderma nullifila* Kowalski (UC), *Synchytrium variabilum* Karling (UC), *Tracya lemnae* (Setch.) Syd. & P. Syd. (UC), and *Trichia synsporum* Kowalski & E. N. McNichols (CHSC).

LIST OF ABBREVIATIONS USED

ATCC - American Type Culture Collection
CBS - Centraalbureau voor Schimmelcultures, Baarn, Netherlands
Co. - County
comm. - communicated by
cult. - culture (dried)
Dept. - Department
Distr.- District
E - east, also W, N, S for west, north, south, and intermediates
elev. - elevation above sea level; altitude
Exper.- experiment
fasc. - fascicle
ft - feet
Herb. - Herbarium
hom. illeg. - illegitimate homonym
Inst. - Institute
km - kilometer (s), m - meter (s), mi - mile (s)
Mt., Mts. - Mountain, Mountains
Nat. - National
no. - number
nom. dub. - nomen dubium
nom. inval. - nomen invalidum
nom. nov. - nomen novum
nom. nud. - nomen nudum
pers. comm. - personal communication
p. p. - pro parte, partly; in part
Prov. - Province
s. n. - sine numero; unnumbered
syn. - synonym; ≡ nomenclatural synonym with same type; = taxonomic synonym with different type
Univ. - University
YpSs - Yeast-Starch agar (Cooney & Emerson, 1964, p. 13)

LIST OF TAXA

Acantharia echinata (Ellis & Everh.) Theiss. & Syd. see *Dimerosporium echinatum*

Achoropeltis modesta Syd. in Syd. & Petr. Ann. Mycol. 27:79. 1929. **ISOTYPE** UC 976889. On leaves of *Eurya seemanniana* Pittier, Piedades de San Ramon, Alajuela Prov., Costa Rica, A. M. Brenes 267, 29.ix.1925. Publication includes many taxa collected in the environs of San Ramon.

Acrospermum candidum Setch. Mycologia 16:241. 1924. **HOLOTYPE** UC 229839. On living sterile leaves (leaves lacking sporangia) of *Lophosoria quadripinnata* (J. F. Gmel.) C. Chr., Cerro de Boqueron, State of Chiapas, Mexico, C. A. Purpus 6715, ix.1913. Host as (syn.) *Alsophila quadripinnata* (J. F. Gmel.) C. Chr. ≡ *Cyanodermella candidum* (Setch.) O. E. Erikss. (Opera Bot. 60:55. 1981) (≡ *Cyanoderma candidum* [Setch.] O. E. Erikss., Ark. Bot. 6:389. 1967 [O. E. Eriksson stated in this publication that there was an isotype at S]). Erroneously listed for California in Farr et al., 1989; distributed as California Fungi 255. Original publication, written after Setchell's arrival in Berkeley, did not state that the single collection was deposited in UC; UC packet is marked 'type' in Setchell's handwriting.

Aecidium alibertiae Arthur
Mycologia 14:21. 1922. **ISOTYPE** UC 681665. On *Alibertia* sp.(?), Piarco Savanna, S of Dabadie, Trinidad, Trinidad and Tobago, West Indies, F. J. Seaver 3286, 21.iii.1921.

Aecidium bethelii Arthur
Bull. Torrey Bot. Club 47:476. 1920. **ISOTYPE** UC 568495. On *Ludwigia peploides* (Kunth) P. H. Raven, Long Beach, Los Angeles Co., California, E. Bethel 15.viii.1916. Host as (syn.) *Jussiaea californica* (S. Watson) Jeps.

Aecidium borrichiae Syd. & P. Syd.
Hedwigia Beiblatt 40:(129). 1901. **ISOTYPE** UC 638222. On *Borrichia frutescens* (L.) DC., Fort Morgan, Baldwin Co., Alabama, S. M. Tracy, 27.iv.1901. "Type" included on original typed label. Collection date not cited in protologue.

Aecidium holwayi H. S. Jacks.
Mycologia 24:97. 1932. **ISOTYPE** UC 479742. On *Borreria latifolia* (Aubl.) K. Schum., Mandaqui (Mandaque), São Paulo area, State of São Paulo, Brazil, E. W. D. Holway & M. M. Holway (Plants of South America 1893), 25.v.1922. Reliquiae Holwayanae 491.

Aecidium hornotinum Cummins
Ann. Mycol. 35:103. 1937. **ISOTYPE** UC 800190. Probably on *Meliosma multiflora* Merr., Mt. Santo Tomas, elev. 6500 ft, Benguet Prov. (sometimes listed as Subprovince), Luzon, Philippines, M. S. Clemens 51803, 26.iii.1935. Label lists as *Meliosma* probably *multiflora*.

Aecidium minimum H. S. Jacks. & Holw. in H. S. Jacks.
Mycologia 24:121. 1932. **ISOTYPE** UC 479682. On *Stevia urticaefolia* Thunb., Ouro Preto, State of Minas Geraes, Brazil, E. W. D. Holway & M. M. Holway (Plants of South America 1366), 6.xii.1921. Reliquiae Holwayanae 551.

Aecidium nectandrae H. S. Jacks. & Holw. in H. S. Jacks.
Mycologia 23:102. 1931. **ISOTYPE** UC 464869. On *Nectandra oppositifolia* Nees & Mart. in Nees, Belo Horizonte, State of Minas Geraes, Brazil, E. W. D. Holway & M. M. Holway (Plants of South America 1339), 26.xi.1921. Reliquiae Holwayanae 232. On label and in protologue, host author (C. G. D. Nees) erroneously listed as Ness.

Aecidium ocfemianum F. Stevens
Philipp. Agric. 20:87. 1931. **ISOTYPE** UC 478696. On *Pisonia alba* Span., Sariaya, Tayabas Prov., Luzon, Philippines, G. O. Ocfemia (F. L. Stevens 198), 9.viii.1930.

Aecidium pereziae Arthur
Bull. Torrey Bot. Club 45:153. 1918. **ISOTYPE** UC 567248. On *Perezia* sp., barranca near Rio Blanco (vicinity of Guadalajara), State of Jalisco, Mexico, C. G. Pringle, 25.vii.1893. Reliquiae Farlowianae 722. Protologue lists Barranca as locality (see Davis, 1937).

Aecidium poecilochromae H. S. Jacks. & Holw. in H. S. Jacks.
Mycologia 24:79. 1932. **ISOTYPE** UC 479788. On *Poecilochroma quitensis* Miers?, Cochabamba, Cochabamba Dept., Bolivia, E. W. D. Holway & M. M. Holway (Plants of South America 363), 3.iii.1920. Reliquiae Holwayanae 443. Author of host misspelled and identification of host questioned in protologue.

Aecidium solidaginicola Ellis & Everh.
Erythea 1:206. 1893. **ISOTYPE** UC 1474802. On *Solidago*, Fort Collins, Larimer Co., Colorado, C. F. Baker 135, vi.1893. Published as *A.*

solidaginicolum, an orthographic error.

Albatrellus flettii Morse ex Pouzar
Česká Mykol. 26:198. 1972. **HOLOTYPE** UC 589805. In shallow black humus of mixed forest, Bremerton, Kitsap Co., Washington, J. B. Flett, autumn 1937 (validation of *Polyporus flettii* Morse, Mycologia 33:507. 1941). ≡ *Polypilus flettii* (Pouzar) Teixeira, Revista Brasil. Bot. 15 (2):126. 1992.

Allomyces reticulatus R. Emers. & J. A. Robertson
Amer. J. Bot. 61:313. 1974. **HOLOTYPE** UC 1445835. Isolated from soil collected near Richvale, Butte Co., California, collector not indicated, 14.x.1967. Cult. isolate "Cal 70."

Anthracoidea atratae (Savile) Kukkonen see *Cintractia atratae*

Anthracoidea douglasii Shear ex Nannf.
Bot. Not. 130:366. 1977. **ISOTYPE** UC 152475. On *Carex douglasii* Boott, Gunnison, Gunnison Co., Colorado, E. T. Bartholomew, 5.ix.1899. Ellis & Everhart's Fungi Columbiani Continued, C. L. Shear, 1485, as *Ustilago caricis douglasii* Shear (1901)--*U. caricis* (Pers.) Unger var. *douglasii* Shear (nom. nud.).

Anthracoidea laxae Kukkonen
Ann. Bot. Soc. Zool.-Bot. Fenn. 'Vanamo' 34(3):90. 1963. **ISOTYPE** UC 1144359. On *Carex laxa* Wahlenb., Kello, Haukipudas, Oulu Prov., Finland, Eino Pallari, 7.vii.1951. Fungi Exsiccati Fennici, Fasc. 6, no. 287, as *Cintractia caricis* (Pers.) Magnus.

Anthracoidea limosa (Syd.) Kukkonen see *Cintractia limosa* var. *minor*

Anthracoidea misandrae Kukkonen
Ann. Bot. Soc. Zool.-Bot. Fenn. 'Vanamo' 34(3):82. 1963. **ISOTYPE** UC 1203318. On *Carex misandra* R. Br., 2 mi E of airport, Frobisher Bay, Baffin Island, Franklin Distr., Canada, D. B. O. Savile, J. A. Calder, I. Kukkonen, 10.viii.1959 (ex DAOM 66933), originally labelled as *Cintractia limosa* Syd. var. *minor* Savile.

Anthracoidea paniceae Kukkonen
Ann. Bot. Soc. Zool.-Bot. Fenn. 'Vanamo' 34(3):76. 1963. **ISOTYPE** UC 1144002. On *Carex panicea* L., Ido, Kōkar, Ahvenanmaa Prov. (Alandia), Finland, Lauri E. Kari, 4.viii.1947. Fungi Exsiccati Fennici Fasc. 3, no. 129.

Anthracoidea verrucosa (Savile) Nannf. see *Cintractia carpophila* var. *verrucosa*

Aphanostigme lanugine V. P. M. Miller & Bonar
Univ. Calif. Publ. Bot. 19:412. 1941. **HOLOTYPE** UC 498806. On underside of living leaves of *Garrya elliptica* Lindl., Bolinas, Marin Co., California, V. P. M. Miller, autumn 1931.

Aqualinderella fermentans R. Emers. & W. Weston
Amer. J. Bot. 54: 715. 1967. **HOLOTYPE** UC 1320293. Cult. CR78 isolated from material collected at Margarita, near Zent, Limon Prov., Costa Rica, R. Emerson, 1957. Saprophytic on fruit submerged in warm, stagnant water. Material from culture of 5.i.1968 distributed as California Fungi 1330.

Arcangeliella crassa Singer & A. H. Sm.
Mem. Torrey Bot. Club 21(3):74. 1960. **ISOTYPE** UC 502880. Under duff in forest, Cow Creek, Stanislaus Nat. Forest, elev. 5700 ft, Tuolumne Co., California, Frank A. Patty, 25.vii.1931, annotated by A. H. Smith.

Arcangeliella magna (Parks) Zeller see *Macowanites magnus*

Arcangeliella scissilis Zeller & C. W. Dodge
Ann. Missouri Bot. Gard. 22:369. 1935. **ISOTYPE** UC 1064980. On soil

under *Sequoia sempervirens* (D. Don) Endl., Spruce Cove, Trinidad, Humboldt Co., California, H. E. Parks 4125, v.1933. ≡ *Martellia scissilis* (Zeller & C. W. Dodge) Singer & A. H. Sm., Mem. Torrey Bot. Club 21(3):415. 1960.

Arcyria elaterensis Mulleavy
Mycologia 69:693. 1977. **HOLOTYPE** UC 1471903. Grown from horse dung collected at Briones Regional Park, Contra Costa Co., California, P. Mulleavy 648, spring 1975.

Arthrobotryum spongiosum Hoerl
Madroño 5:75. 1939. **HOLOTYPE** UC 596853. On *Calocedrus decurrens* (Torr.) Florin, above 18 Mile Creek, Smith River, Del Norte Co., California, H. E. Parks 4422, 19.iv.1933. ≡ *Capnocybe spongiosa* (Hoerl) S. Hughes, New Zealand J. Bot. 4:349. 1966.

Ascochyta salicis Bonar
Mycologia 38:342. 1946. **HOLOTYPE** UC 697789. On living leaves of *Salix laevigata* Bebb, Hastings Natural History Reservation, E. Carmel Valley Road, Monterey Co., California, J. M. Linsdale, 12.vi.1941.

Asteromella castanicola (Ellis & Everh.) Petrak see *Phyllosticta castanicola*

Athelia alutacea Jülich
Willdenowia Beih. 7:51. 1972. **ISOTYPES** UC 151339, 44534. On decaying limbs lying on ground, Newfield, Gloucester Co., New Jersey, J. B. Ellis, xi.1863; Ellis & Everhart Fungi Columbiani 309 (labelled as *Corticium arachnoideum* Berk.), designated as type collection by Jülich in protologue. Jülich, 1972, gave collector as Ellis; UC 151339 and 44534 annotated as *Athelia alutacea* by Jülich, 1971, but not marked as isotypes. Ellis & Everhart Fungi Columbiani 309 cited as *Corticium centrifugum* (Lév.) Bres. by Burt, 1926, Ann. Missouri Bot. Gard. 13:206.

Aureobasidium umbellulariae (J. M. Harvey) Hermanides-Nijhof see *Kabatiella phoradendri* (L. Darling) J. M. Harvey f. *umbellulariae* J. M. Harvey.

Bacidia cateilea (Vain.) R. Sant. see *Pilocarpon cateileum*

Bacidia melancheiloides Vain. *LICHEN*
Univ. Calif. Publ. Bot. 12:8. 1924. **ISOTYPE** UC 261075. On trees in the Purau Swamp beyond Maraa Caves, Paea Distr., Tahiti, Society Islands, W. A. Setchell (Tahiti no. 5409) with H. E. Parks, 29.v.1922. Specimen in TUR-V not annotated as holotype or lectotype (see Alava, 1988, p. 41). Setchell's correspondence in UC with Vainio suggests that a portion of each collection of Tahitian material in this list was sent to Vainio, by whom it was retained and studied; UC specimens have been compared with the protologues.

Badhamia bispora K. D. Whitney
Mycologia 70:672. 1978. **HOLOTYPE** UC 1465150. On decayed coniferous wood, Eagle Lake Field Station, Lassen Co., California, K. D. Whitney 529, 27.vi.1977.

Badimia cateilea (Vain.) Lücking, Lumbsch & Elix see *Pilocarpon cateileum*

Baeomyces weberi J. W. Thomson *LICHEN*
Bryologist 73:632. 1970. **ISOTYPE** UC 1447683. Mount Kaindi near Wau, Morobe Distr., New Guinea, W. A. Weber & D. McVean, 18.vi.1968. Lichenes Exsiccati distributed by the Univ. of Colorado Museum, Boulder 333.

Blastocladiopsis elegans J. A. Robertson
Canad. J. Bot. 54:614. 1976. **HOLOTYPE** UC 1457287. Cult. isolated from

soil collected at Virginia Beach, Princess Ann Co., Virginia, C. Wilson, 2.ix.1970. Saprophytic on fly placed in collected soil.

Bonaria lithocarpi (V. P. M. Miller & Bonar) Bat. see *Protopeltis lithocarpi*

Buellia multispora Kalb & Vězda *LICHEN*
Folia Geobot. Phytotax. 14:203. 1979. **ISOTYPE** UC 1473794. On bark of *Leucaena* sp., Keawaula Valley, Oahu, Hawaii, O. Degener & I. Degener 34257, 16.iii.1977. A. Vězda: Lichenes Selecti Exsiccati 1670.

Byssocorticium californicum Jülich
Willdenowia 7:141. 1972. **HOLOTYPE** UC 1445761. On bark of log of *Pinus muricata* D. Don, 1 mi SE of Inverness, Marin Co., California, L. B. O'Brien, 28.ii.1965.

Caeoma torreyae Bonar
Mycologia 43:62. 1951. **HOLOTYPE** UC 804620. On leaves of *Torreya californica* Torr., Chute Camp Road, Iowa Canyon, El Dorado Co., California, L. Bonar & J. W. Duffield, 18.xi.1948. California Fungi 755.

Calbovista subsculpta Morse ex Seidl
Mycotaxon 54:390. 1995. **HOLOTYPE** UC 525436. Soda Springs, 6767 ft elev., Nevada Co., California, W. H. Sanders, 9.v.1934 (validation of *Calbovista subsculpta* Morse, Mycologia 27:97. 1935; Morse, p. 99, in her list of five collectors of Soda Springs specimens, included Saunders and a range of dates). Specimen label gives Sanders, 9.v.1934.

Caloplaca stantonii W. A. Weber ex Arup *LICHEN*
Bryologist 95:454. 1992. **ISOTYPE** UC 1570834. On crumbling rock, outcrop in deep barranca, Fraser Point, Santa Cruz Island, Santa Barbara Co., California, W. A. Weber, C. Bratt & T. Hogan, 25.iii.1986, Lichenes Exsiccati distributed by the Univ. of Colorado Museum, Boulder 672.

Calvatia lloydii Zeller & Coker in Zeller
Mycologia 39:301. 1947. **HOLOTYPE** UC 698059. Along Halstead Creek Trail, near Halstead Meadow, Sequoia Nat. Park, Tulare Co., California, L. Bonar, 28.vii.1945 (UC 698059 cited as type on p. 302 of protologue).

Cantharellus bonarii Morse
Mycologia 22:219. 1930. **HOLOTYPE** UC 525463. Kings Canyon Nat. Park (formerly General Grant Nat. Park), Fresno-Tulare Co. line, California, N. Nielsen & F. Mitchell, ix.1927. ≡ *Gomphus bonarii* (Morse) Singer, Lloydia 8:140. 1945. Specimen label written by V. P. Mentzer [Miller] gave E. Morse as collector of type.

Cantharellus wilkinsae Morse in A. H. Sm. & Morse
Mycologia 39:528. 1947. **HOLOTYPE** UC 659985. Near roots of *Abies magnifica* Andrew Murray bis (1812-1878), near Bryant Creek Tract, El Dorado Nat. Forest, El Dorado Co., California, E. Wilkins, 19.X.1941 (date on specimen). ≡ *Gomphus bonarii* (Morse) Singer f. *wilkinsae* (Morse) R. H. Petersen, Nova Hedwigia 21:35. 1971.

Capnocybe spongiosa (Hoerl) S. Hughes see *Arthrobotryum spongiosum*

Capnodium spongiosum M. E. Barr
Canad. J. Bot. 33:512. 1955. **HOLOTYPE** UC 681382. On *Calocedrus decurrens* (Torr.) Florin, above 18 Mile Creek, Smith River, Del Norte Co., California, H. E. Parks, ?xi.1938. ≡ *Strigopodia spongiosa* (M. E. Barr) M. E. Barr, Contr. Univ. Michigan Herb. 9:622. 1972. California Fungi 418 at UC, issued as *Arthrobotryum spongiosum* Hoerl, included material from iv.1937 and xi.1938; perhaps this teleomorphic taxon was

part of the collection of xi.1938; original labels missing.

Ceracea aureo-fulva Bres. in [K.] W. Krieger
Ann. Mycol. 4:39. 1906. **ISOTYPE** UC 1268441. On gymnosperm wood, Sachsische Schweiz (south of Dresden near border of Czech Republic), Germany, [K.] W. Krieger, x.1905. Krieger Fungi Saxonici 1909. McNabb, New Zealand J. Bot. 11:474. 1973, listed no. 1909 as isotype and = *Dacrymyces corticioides* Ellis & Everh., J. Mycol. 1:149. 1885.

Ceratobasidium oryzae-sativae P. S. Gunnell & R. K. Webster
Mycologia 79:731-732. 1987. **HOLOTYPE** UC 1475044. On leaves of *Oryza sativa* L. inoculated with *Rhizoctonia oryzae-sativae* (Sawada) Mordue in greenhouse, Davis, Yolo Co., California, P. S. Gunnell & R. K. Webster, coll. date not indicated.

Ceratocystis radicicola (Bliss) C. Moreau see *Ceratostomella radicicola*

Ceratocystis wageneri Goheen & F. W. Cobb
Phytopathology 68:1193. 1978. **HOLOTYPE** UC 1445965. On roots of *Pinus ponderosa* Lawson, Butcher's Corral, El Dorado Co., California, D. J. Goheen & F. W. Cobb, Jr., 1974-1975. ≡ *Ophiostoma wageneri* (Goheen & F. W. Cobb) T. C. Harr., Mycotaxon 28:42. 1987. Teleomorph of *Verticicladiella wageneri* W. B. Kendr.

Ceratophacidium aristosporum (Bonar) J. Reed & Piroz. see *Pezizella aristospora*

Ceratostomella radicicola Bliss
Mycologia 33:468. 1941. **ISOTYPE** UC 653559. Cultured from roots and trunk of *Phoenix dactylifera* L., Indio, Riverside Co., California, D. E. Bliss cult. B-261, 16.iv.1941. ≡ *Ceratocystis radicicola* (Bliss) C. Moreau, Rev. Mycol. Suppl. Colon. 17:22. 1952; ≡ *Ophiostoma radicicola* (Bliss) Arx, Antonie van Leeuwenhoek J. Microbiol. Serol. 18:211. 1952. Teleomorph of *Chalaropsis* sp. isolated from roots of mature date palms. De Hoog (Stud. Mycol. 7: 1. 1974) gives *Chalaropsis* as conidial state of *Ceratocystis*.

Cercospora broussonetiae Chupp & Linder
Mycologia 29:27. 1937. **ISOTYPE** UC 621672. On *Broussonetia* sp., Ta Tseh Tsuen, Yung Hsien, Kwangsi Prov., China, S. Y. Cheo 2900, 17.x.1933. Ta Tseh Tsuen not on label; otherwise label provides same data as protologue. Reliquiae Farlowianae 827.

Cercospora caloloma Petr.
Sydowia 4:569. 1950. **ISOTYPE** UC 800993. On leaves of *Freziera nervosa* Humb. & Bonpl. (as syn. *Eurya nervosa* Blume), Hacienda San Antonio near Baños, Tungurahua Prov., Ecuador, H. Sydow 501, 10.xii.1937. See Chupp, 1953. On label as *Eurya* sp.

Cercospora ligusticicola Bonar
Mycologia 38:343. 1946. **HOLOTYPE** UC 697787. On living leaves of *Ligusticum grayii* J. M. Coult. & Rose, Bear Creek, Plumas Co., California, L. Bonar, 30.vii.1942. Mentioned by Braun, Nova Hedwigia 50:500. 1990.

Cercosporella californica Bonar
Mycologia 34:188. 1942. **HOLOTYPE** UC 653836. On living leaves of *Toxicodendron diversilobum* (Torr. & A. Gray) Greene, Skyline Blvd., San Mateo Co., California, L. Bonar, 15.viii.1935.

Chadefaudia polyporolithi (Bonar) Kohlm. see *Mycophycophila polyporolithi*

Chaetasbolisia californiana Bat., Cif. & Nascim.
Quad. Lab. Crittog. Ist. Bot. Univ. Pavia 31:57. 1963. **HOLOTYPE** UC 151179. On leaves of *Heteromeles arbutifolia* (Lindl.) M. Roem.,

Berkeley, Alameda Co., California, W. C. Blasdale, iii.1893. Specimen is Ellis & Everhart Fungi Columbiani 114, labelled *Capnodium heteromeles* Cooke & Harkn. See also Mycotaxon 34: 206. 1989 for discussion by Reynolds.

Chaetasbolisia falcata V. P. M. Miller & Bonar
Univ. Calif. Publ. Bot. 19:413. 1941. **HOLOTYPE** UC 498797. On *Lithocarpus densiflora* (Hook. & Arn.) Rehder, Inverness Ridge, Marin Co., California, L. Bonar, 21.ii.1932. California Fungi 607.

Chaetocladium benjaminii Embree
Mycologia 54:305. 1962. **HOLOTYPE** UC 1206512. On carnivorous animal dung, Green Valley Falls, Solano Co., California, R. W. Embree, ii.1961. ≡ *Piptocephalis benjaminii* (Embree) R. K. Benj., Aliso 5: 284. 1963.

Chaetomium thermophile La Touche var. ***coprophile*** Cooney & R. Emers.
Cooney & Emerson, Thermophilic Fungi, 1964, p. 68. **HOLOTYPE** UC 1206514. On incubated horse dung, near Berkeley, Alameda Co., California, D. G. Cooney & R. Emerson cult. no. 4, 1950.

Chaetomium thermophile La Touche var. ***dissitum*** Cooney & R. Emers.
Cooney & Emerson, Thermophilic Fungi, 1964, p. 68. **HOLOTYPE** UC 1206513. On incubated *Typha* straw and leaf mold, near Berkeley, Alameda Co., California, D. G. Cooney & R. Emerson cult. no. 1A, 1949.

Chaetotrichum macrosporum Bonar
Mycologia 34:189. 1942. **HOLOTYPE** UC 653859. On twigs of *Gaultheria shallon* Pursh, north of Trinidad, Humboldt Co., California, H. E. Parks, 10.v.1931, = *Sporidesmium socium* M. B. Ellis, Mycol. Pap. 70:44. 1958. According to Ellis, 1958, p. 44, description indicates nomen confusum of two elements: *Sporidesmium socium* growing on conidiophores of *Helminthosporium velutinum* Link: Fr. *Chaetotrichum macrosporum* was described as a species of *Chaetotrichum* Syd. (Ann. Mycol. 25:150. 1927), a later homonym of *Chaetotrichum* Rabenh. (Deutschlands Kryptogamen-flora 1:68. 1844). California Fungi 611.

Cintractia atratae Savile
Canad. J. Bot. 30:423. 1952. **ISOTYPE** UC 1458004. On *Carex atrata* L., Lake Grinnell, Glacier Nat. Park, Glacier Co., Montana, E. T. Bartholomew, 27.viii.1915. Fungi Columbiani--E. Bartholomew 4908 as *Cintractia caricis* (Pers.) Magnus. ≡ *Anthracoidea atratae* (Savile) Kukkonen, Ann. Bot. Soc. Zool.-Bot. Fenn. 'Vanamo' 34(3):80. 1963.

Cintractia caricis (Pers.: Pers.) Magnus var. ***acutarum*** Savile
Canad. J. Bot. 30:425. 1952. **ISOTYPE** UC 1064810. On *Carex aquatilis* Wahl., South Intake, 40 mi E of Dawson, Yukon Territory, Canada, J. A. Calder 4588, 20.viii.1949, ex DAOM no. 28171. = *Anthracoidea heterospora* (B. Lindeb.) Kukkonen (see Vánky, Symb. Bot. Upsal. 24(2):25. 1985).

Cintractia carpophila (Schumach.) Liro var. ***verrucosa*** Savile
Canad. J. Bot. 30:420. 1952. **ISOTYPE** UC 775378. In ovaries of *Carex ebenea* Rydb. (as *C. festivella* Mack.), Lake Marie, Medicine Bow Mts., Carbon Co., Wyoming, W. G. Solheim 2009, 21.viii.1941. Mycoflora Saximontanensis Exsiccata 439, as *Cintractia caricis* (Pers.) Magnus; ≡ *Anthracoidea verrucosa* (Savile) Nannf., Bot. Not. 130:372. 1977.

Cintractia limosa Syd. var. ***minor*** Savile
Canad. J. Bot. 30:426. 1952. **ISOTYPE** UC 966800. On *Carex bigelowii* Torr., Great Whale River, northwestern Quebec, Canada, D. B. O. Savile 536, 28.vii.1949, ex DAOM no. 28197. Included as *Anthracoidea limosa* (Syd.) Kukkonen by Kukkonen, Ann. Bot. Soc. Zool.-Bot. Fenn. 'Vanamo' 34 (3):5,18-22. 1963, who discussed variation in this

species; this variety was not mentioned.

Cladidium thamnitis (Tuck.) Hafellner see *Lecanora thamnitis*

Clasterosporium obclavatum Bonar [non *C. obclavatum* (Cooke) Sacc., Syll. Fungorum 4:386. 1886] see *Sporidesmium bonarii*

Clithris sequoiae Bonar
Mycologia 34:183. 1942. **HOLOTYPE** UC 653855. On dead branches of *Sequoia sempervirens* (D. Don) Endl., Trinidad, Humboldt Co., California, H. E. Parks 4020, xi.1931. Possibly belongs in *Colpoma*; see Hawksworth et al., 1983, Farr et al., 1989.

Clitocybe eccentrica Peck
Bull. Torrey Bot. Club 25:321. 1898. **ISOTYPE** UC 452220. S. Dunmore above cascades, Addison Co., Vermont, E. A. Burt, 17.viii.1897, packet marked: from the type collection. "Near S. Dunmore" is type locality listed by Bigelow, 1982, p. 132, although it is not in protologue.

Coleosporium cheoanum Cummins
Mycologia 42:788. 1950. **ISOTYPE** UC 927865. On *Coleus* sp., Fan Chin Shan, Chiang K'ou Hsien, Kweichow Prov., China, S. Y. Cheo 548, 21.ix.1931.

Collema thysanaeopsis Vain. *LICHEN*
Univ. Calif. Publ. Bot. 12:8. 1924. **ISOTYPE** UC 261062. On trees near Isthmus of Taravao, Hitiaa Distr., Tahiti, Society Islands, W. A. Setchell (Tahiti no. 5336) with H. E. Parks, 24.vi.1922. = *Collema coilocarpum* (Müll. Arg.) Zahlbr., Symb. Bot. Upsal. 20(2): 145. 1974; in this publication, Degelius listed specimen at TUR-V as lectotype.

Comatricha anastomosans Kowalski
Mycologia 64:362. 1972. **ISOTYPE** UC 1445505. Three mi below Sunrise Point, Mt. Rainier Nat. Park, 5000 ft elev., Pierce Co., Washington, D. T. Kowalski 10623, 23.vi.1970. In this publication, Kowalski stated that type material was deposited in three herbaria. The type material retained in Kowalski's herbarium, now in CHSC, is here designated as lectotype.

Coprinus asterophorus Long & V. P. M. Miller
Mycologia 37:120. 1945. **HOLOTYPE** UC 733961. Guadalupe Trail, 4 mi N of Albuquerque, Bernalillo Co., New Mexico, W. H. Long 9354, 12.vi.1941.

Cornuella lemnae Setch. (non *Cornuella* Pierre, Notes Botaniques. Sapotacées, p. 66, January 1891) see *Tracya lemnae*

Cortinarius calyptrodermus A. H. Sm.
Bull. Torrey Bot. Club 69:51. 1942. **ISOTYPE** UC 686604. In woods of second-growth *Quercus* and *Tilia* (basswood), Sharron Hollow, Chelsea, Washtenaw Co., Michigan, A. H. Smith 15356, 14.ix.1940.

Cortinarius magnivelatus Dearn. ex Fogel
Mycologia 86:797. 1994. **HOLOTYPE** UC 638890. General Grant Nat. Park (now incorporated into Kings Canyon Nat. Park), Fresno-Tulare Co. line, California, E. E. Morse, vii.1927 (validation of *Pholiota magnivelata* Dearn. in Morse, Mycologia 33:367. 1941); = *Cortinarius magnivelatus* (Morse) A. H. Sm. & Thiers, Mycologia 61:534. 1969 (not validated with Latin diagnosis).

Cortinarius volvatus A. H. Sm.
Contr. Univ. Michigan Herb. 2:12. 1939. **ISOTYPE** UC 629437. Under *Picea sitchensis* (Bong.) Carrière, Crescent City, Del Norte Co., California, A. H. Smith 8857, 18.xi.1937.

Cudonia spathulata S. Imai
Bot. Mag. (Tokyo) 56:524. 1942. **HOLOTYPE** UC 439652. Big Basin, Santa Cruz Co., California, H. E. Bailey, 22.ii.1931. ≡ *Spathularia*

spathulata (S. Imai) Mains, Mycologia 47:869. 1955; ≡ *Pachycudonia spathulata* (S. Imai) S. Imai, Bot. Mag. (Tokyo) 63:235. 1950.

Cunninghamella meineckella A. J. Olson
Phytopathology 31:1076. 1941. **HOLOTYPE** UC 663294. On roots of *Pinus jeffreyi* Grev. & Balf. and *Pinus ponderosa* Lawson, Lasco, Lassen Co., California, A. J. Olson, spring 1937--June 1940. ≡ *Spiniger meineckellus* (A. J. Olson) Stalpers, Koninkl. Nederl. Akad. Wetensk. ser. C, 77:402. 1974 (listed as *Spiniger meineckellum* in Farr et al., 1989).

Cyanodermella candidum (Setch.) O. E. Erikss. see *Acrospermum candidum*

Cylindrocarpon liriodendri J. D. MacDon. & E. E. Butler
Pl. Dis. Reporter 65:156. 1981. **HOLOTYPE** UC 1475003. On roots of *Liriodendron tulipifera* L., Davis, Yolo Co., California, J. D. MacDonald & E. E. Butler, March, June 1978. Cult.

Cylindrosporium acerinum Tracy & Earle in M. E. Jones
Proc. Calif. Acad. Sci. (ser. 2) 5:732. 1895. **ISOTYPE** UC 371304. On *Acer glabrum* Torr., Marysvale, elev. 8000 ft, Piute Co., Utah, Marcus E. Jones 5917, 27.viii.1894. Farr, et al., 1989, p. 658, suggested it may be syn. of *Septoria aceris* (Lib.) Berk. & Broome.

Cylindrosporium artemisiae Dearn. & Barthol. in Dearn.
Mycologia 9:358. 1917. **ISOTYPE** UC 1458206. On *Artemisia suksdorfii* Piper, Pleasant Beach, south shore of Bainbridge Island, Kitsap Co., Washington, E. Bartholomew, 22.viii.1912. Fungi Columbiani--E. Bartholomew 5010 (labelled as type collection). No. 5010 mentioned in protologue, which lists locality as Pleasant Beach, Washington, Bartholomew 4892, August 1912. According to Braun, Nova Hedwigia 58:219. 1994, this collection is a *Septoria*.

Cylindrosporium corni Solheim
Mycologia 41:630. 1949. **ISOTYPE** UC 775427. On living leaves of *Cornus stolonifera* Michx., Six Mile Gap, Platte River, Medicine Bow Mountains, Carbon Co., Wyoming, W. G. Solheim 2224, 7.ix.1948. Mycoflora Saximontanensis Exsiccata 488.

Cylindrosporium longisporum Ellis & Dearn.
Canad. Rec. Sci. 1893:270. 1893. **ISOTYPE** UC 152129. On leaves of *Lupinus perennis* L., London, Middlesex Co., Ontario Prov., Canada, J. Dearness, vii.1891. Ellis & Everhart Fungi Columbiani 1065. Protologue lists North American Fungi 2784 (also on label, lower right), Herb. D 791 (latter not on label); = *Cercospora longispora* Peck (see Farr et al, 1989, listed as *Cylindrosporium longisporium*)

Cylindrosporium rhamni Ellis & Everh.
Proc. Acad. Nat. Sci. Philadelphia 47:435. 1895. **ISOTYPE** UC 976744. On *Rhamnus purshiana* DC., Shasta Springs, Siskiyou Co., California, W. C. Blasdale, 7.viii.1894, Label has 283 in upper right corner and *purshiana* is written across sp. Protologue lists Blasdale 283, omits date, lists host as *Rhamnus* sp.

Cylindrosporium saximontanense Solheim
Mycologia 41:630. 1949. **ISOTYPE** UC 775429. On leaves of *Populus angustifolia* E. James, Ouray Picnic Grounds, Ouray, Ouray Co., Colorado. W. G. Solheim & R. Solheim 2258, 12.x.1948. Mycoflora Saximontanensis Exsiccata 490.

Cytospora aberrans Sacc.
Ann. Mycol. 12:307. 1914. **ISOTYPES** UC 364852, UC 210686. On *Citrus* sp., Santo Tomas, Batangas Prov., Luzon, Philippines, P. W. Graff, xi.1912. Bureau of Science no. 20945.

Cytospora pallida Ellis & Everh.
J. Mycol. 8:12. 1902. **ISOTYPE** UC 152792. On dead fallen limbs of *Quercus velutina* Lam. (as *Q. tinctoria*), Newfield, Gloucester Co., New Jersey, J. B. Ellis, xi.1901-iv.1902. Ellis & Everhart's Fungi Columbiani by E. Bartholomew 1617 (as *Cytispora pallida*)

Dacrymyces enatus (Berk. & M. A. Curtis) Massee var. **macrosporus** L. L. Kennedy
Mycologia 50:902. 1958. **ISOTYPE** UC 1450553. Barro Colorado Island, Canal Zone, Panama, G. W. Martin & A. L. Welden 8662, 23.viii.1952.

Dacrymyces variisporus McNabb
New Zealand J. Bot. 11:504. 1973. **ISOTYPE** UC 976046. On stump of *Pinus ponderosa* Lawson, Falcon Valley, Klickitat Co., Washington, W. N. Suksdorf 475, 25.ix.1894. Reliquiae Suksdorfiana 15 (as *Dacrymyces abietinus* of authors, non [Pers.: Pers.] Schroet. in Cohn, 1888, Kryptogamen-Flora von Schlesien vol. 3, pt. 1).

Dactylospora arthrobotryina Hafellner
Beih. Nova Hedwigia 62:97. 1977. **HOLOTYPE** UC 1139330. On *Arthrobotryum spongiosum* Hoerl, Smith River, Del Norte Co., California, H. E. Parks 5581, x.1935. Originally labelled by Bonar as *Karschia stygia* (Berk. & M. A. Curtis) Massee.

Daleomyces gardneri Setch.
Mycologia 16:241. 1924. **LECTOTYPE** UC 229838. Univ. of California campus, Berkeley, Alameda Co., California, H. E. Parks 1412 with L. D. Parks, 22.i.1923. = *Peziza proteana* (Boud.) Seaver f. *sparassoides* (Boud.) Korf, Mycologia 48: 714. 1956. Lectotypified by Korf, p. 715, who listed it as holotype following Setchell's own designation of the type on the herbarium specimen; of two collections listed, the protologue did not indicate which is the type.

Diacheopsis effusa Kowalski
Mycologia 67: 623. 1975. **LECTOTYPE** UC 1145912. Serene Lake, 6700 ft elev., Placer Co., California, D. T. Kowalski 11857, 30.vi.1971. Kowalski listed UC and DTK (Kowalski Herb.) for holotypes; DTK has been incorporated in CHSC, which lacks this collection (pers. comm. from Richard Critchfield, 5.ii.1993). UC 1145912 is here designated lectotype.

Diacheopsis serpula Kowalski
Mycologia 67:619. 1975. **ISOTYPE** UC 1445914. 2 mi below Hurricane Ridge, Olympic Nat. Park, 4850 ft elev., Whatcom Co., Washington, D. T. Kowalski 12612, 25.vi.1972. Specimen at CHSC is designated lectotype (CHSC specimens regarded as holotypes; however, publication lists holotypes at UC and in Kowalski coll.).

Diaporthopsis sclerophila Bonar
Amer. J. Bot. 53:184. 1966. **HOLOTYPE** UC 1273535. On *Baccharis pilularis* DC. var. *consanguinea* (DC.) Kuntze, W slope of Little Grizzly Peak, Berkeley, Alameda Co., California, L. Bonar, 3.ii.1965. California Fungi 1243. Host variety not recognized as distinct in Hickman, 1993.

Dichomera prunicola Ellis & Dearn. in Sacc.
Syll. Fungorum 22:1085. 1913. **ISOTYPE** UC 155394. On *Prunus virginiana* L., London, Middlesex Co., Ontario Prov., Canada, J. Dearness, 13.x.1903. Ellis and Everharts' Fungi Columbiani by E. Bartholomew 2021, which was listed in original protologue, where date was omitted. Saccardo published diagnosis sent by Dearness.

Didymaria wyethiae (Ellis & Everh.) Solheim see *Marssonia wyethiae*

Didymella conchae Bonar *LICHEN*
Univ. Calif. Publ. Bot. 19:188. 1936. **HOLOTYPE** UC 554476. On *Acmaea digitalis* Eschscholz (limpet), Land's End, San Francisco, San Francisco Co., California, L. Bonar, 21.viii.1932. Annotated by Keissler as syn. of *Paraphysothele halodytes* (Nyl.) Keissl. in Rabenhorst, Kryptogamenflora von Deutschland, Österreich und der Schweiz, vol. 9(1:2):213. 1937; said to be syn. of *Arthropyrenia halodytes* (Nyl.) Arnold by Swinscow, Lichenologist 3:55. 1965 (syn. of *Pyrenocollema halodytes* [Nyl.] R. C. Harris in Egan [Bryologist 92:164. 1989]), and said to be syn. of *Pharcidia balani* (Har. ex G. Wint.) Bauch by Kohlmeyer, Trans. Brit. Mycol. Soc. 50:137. 1967. However, these taxa presumably are not all synonymous and material on California intertidal molluscs needs careful study.

Didymium disciforme Kowalski & T. N. Lakh.
Mycologia 65:474. 1973. **ISOTYPE** UC 1445691. On dead leaves of *Ficus benghalensis* L., from Botanical Garden, Hans Raj College, Delhi, India, T. N. Lakhanpal 171, 12.x.1971. Published as *D. disciformis*. Holotype at CHSC; pers. comm. from Richard Critchfield, Feb. 5, 1993. According to publication, a portion of type is in UC and rest in authors' herbaria; CHSC specimen is here designated lectotype.

Didymium nullifilum (Kowalski) M. L. Farr see *Squamuloderma nullifilum*

Diedickea piceae Bonar
Mycologia 34:185. 1942. **HOLOTYPE** UC 653851. On leaves of *Picea sitchensis* (Bong.) Carrière, Trinidad, Humboldt Co., California, H. E. Parks 3890, v.1931. California Fungi 624.

Dimargaris bacillispora R. K. Benj.
Aliso 4:376. 1959. **ISOTYPE** UC 1270737. Isolated from mouse dung at Jenks Lake, San Bernardino Mountains, San Bernardino Co., California, R. K. Benjamin RSA cult. 592, 26.vii.1957. Cultured on *Cokeromyces recurvatus* Poitras on YpSs, 12-25.x.1962.

Dimargaris cristalligena Tiegh.
(Ann. Sci. Nat., Bot., ser. 6, 1:154. 1875)
Aliso 4:365. 1959. **ISONEOTYPE** UC 1270731. Isolated from mouse dung at Evey Canyon, NE of Claremont, Los Angeles Co., California, R. K. Benjamin RSA cult. 468, 28.iv.1956. Cultured on *Cokeromyces recurvatus* Poitras on YpSs, 12-25.x.1962. Designated as neotype by Benjamin, 1959.

Dimargaris verticillata R. K. Benj.
Aliso 4:374. 1959. **ISOTYPE** UC 1270734. Isolated from mouse dung at Claremont, Los Angeles Co., California, R. K. Benjamin RSA cult. 527, 26.ii.1957. Cultured on *Cokeromyces recurvatus* Poitras on YpSs, 12-25.x.1962.

Dimeriella pseudotsugae V. P. M. Miller & Bonar
Univ. Calif. Publ. Bot. 19:405. 1941. **HOLOTYPE** UC 498795. On lower side of leaves of young *Pseudotsuga menziesii* (Mirb.) Franco, Mill Creek, near Trinidad, Humboldt Co., California, H. E. Parks 3680 with J. P. Tracy, v.1931; ≡ *Rasutoria pseudotsugae* (V. P. M. Miller & Bonar) M. E. Barr, Mycotaxon 29:501. 1987; ≡ *Epipolaeum pseudotsugae* (V. P. M. Miller & Bonar) Shoemaker, Canad. J. Bot. 43:631. 1965. California Fungi 626.

Dimerosporium echinatum Ellis & Everh.
Erythea 1:145. 1893. **ISOTYPE** UC 44625. On *Quercus chrysolepis* Liebm., Jackson, Amador Co., California, G. Hansen, 1892. "Earliest collection" written on packet by Lee Bonar; ≡ *Acantharia echinata*

(Ellis & Everh.) Theiss. & Syd., Ann. Mycol. 16:15. 1918.

Diplodia durionis Sacc. & Syd. in Sacc.
Ann. Mycol. 11:318. 1913. **ISOTYPE** UC 528213. On seed coats of *Durio zibethinus* Murray, Los Baños, Laguna Prov., Luzon, Philippines, C. F. Baker, 11.ix.1912. Publication does not indicate if authors are Sacc., Syd., & P. Syd.; on p. 314, Saccardo lists Syd. for *Eutypa falcata* Syd. & P. Syd. (Ann. Mycol. 10:406. 1912).

Diplodia sassafras Tracy & Earle
Bull. Torrey Bot. Club 1895:177. 1895. **ISOTYPES** UC 44631, 153012, 152225. On *Sassafras*, Starkville, Oktibbeha Co., Mississippi, S. M. Tracy, 15.iv.1894; Ellis & Everhart, North American Fungi--second series 3366 (UC 153012), Ellis & Everhart Fungi Columbiani 969 (UC 152225); = *Diplodia inconspicua* Cooke according to Zambettakis, Bull. Soc. Mycol. France 70:2. 1954.

Diploplenodomus fungicola Bonar
Mycologia 57:389. 1965. **HOLOTYPE** UC 1272184. On hymenial surface of *Aleurodiscus penicillatus* Burt on dead twigs, Trinidad, Humboldt Co., California, H. E. Parks 6997, i.1947. Protologue citation of 1957 is incorrect.

Dipodascus geotrichum (E. E. Butler & L. J. Petersen) Arx see *Endomyces geotrichum*

Dirina catalinariae Hasse f. ***sorediata*** Tehler *LICHEN*
Opera Bot. 70:36. 1983. **ISOTYPE** UC 1570897. On cliffs by the sea, Punta Banda, near La Bufadora, 40-50 km S of Ensenada, Baja California, Mexico, A. Tehler 1665, 29.vii.1976. Exact date is not in protologue or elsewhere in the publication.

Disaeta arbuti Bonar
Mycologia 20:299. 1928. **LECTOTYPE** UC 469490. On living leaves of *Arbutus menziesii* Pursh, Mt. Tamalpais, Marin Co., California, L. Bonar, 23.iii.1927. ≡ *Seimatosporium arbuti* (Bonar) Shoemaker, comb. nov., Canad. J. Bot. 42:416. 1964. Lectotypified by Sutton (1980, p. 283), who stated "IMI 86040 ex UC, holotype." Presumably IMI 86040 was a portion retained from loan in 1961 of UC 469490. [UC 469593, Oakland, California, i.1923 also cited, Bonar, 1928, but type collection not indicated in protologue.]

Dispira parvispora R. K. Benj.
Aliso 5:281. 1963. **ISOTYPE** UC 1270736. Cultured from rodent dung at Mon Bluff, at junction of road to Woody and Poso Creek Road, 10 mi NNE of Oildale, Kern Co., California, R. K. Benjamin RSA cult. 1196, 4.iv.1962. Cultured on *Cokeromyces recurvatus* Poitras on YpSs, 12.xii.1962-4.i.1963.

Ditopella asclepiadea Bonar
Mycologia 57:382. 1965. **HOLOTYPE** UC 1272180. On *Asclepias fascicularis* Decne.? (as *A. mexicana* Cav.), 5 mi N of Lake Arrowhead, San Bernardino Co., California, L. Bonar, 14.iii.1957. California Fungi 1245. Apparently incorrectly placed in *Ditopella* according to Barr, 1978, Mycologia Memoirs 7:161; Barr suggested it might belong in *Delphinella* or *Plurisperma*.

Doassansia epilobii Farl.
Bot. Gaz. 8:277. 1883. **ISOTYPE** UC 48774. On *Epilobium alpinum* L., King's Ravine, White Mts., Coos Co., New Hampshire, W. G. Farlow, ix.1882; = *D. epilobii* K. W. Krieg., Fungi Saxonici no. 1951 (1906), a later homonym (see Vánky, Symb. Bot. Upsal. 24[2]:42. 1985); no. 1951 is UC 1268483.

Doassansia intermedia Setch.
Bot. Gaz. 19:185. 1894. **ISOLECTOTYPE** UC 48738. On *Sagittaria latifolia* Willd. (syn. *S. variabilis* Engelm.), Shelburne, Coos Co., New Hampshire, W. G. Farlow, ix.1893; ≡ *Doassansiopsis intermedia* (Setch.) Vánky, Sydowia 34:171. 1981 (lectotype indicated for S [as type]). Type locality selected by Zundel 1953, p. 227, thus indicating which of the specimens listed by Setchell was the type collection.

Doassansiopsis intermedia (Setch.) Vánky see *Doassansia intermedia* Setch.

Dothichiza garryae Bonar
Mycologia 34:187. 1942. **HOLOTYPE** UC 653856. On living or dead leaves of *Garrya elliptica* Lindl., San Rafael Hills, Marin Co., California, L. Bonar, i.1925.

Dothidotthia lasioderma (Ellis & Everh.) M. E. Barr see *Leptosphaeria lasioderma*

Dothiorella adanensis Petr.
Sydowia 7:34. 1953. **ISOTYPE** UC 976935. On decaying branches of *Vitex agnus-castus* L., Adana, Adana Prov., Turkey, G. Karel, 22.i.1948.

Dothiorellina quickii Bonar
Mycologia 57:389. 1965. **HOLOTYPE** UC 967048. On stromata of *Grovesiella abieticola* (Zeller & Goodding) M. Morelet & Gremmen, on bark of dead twigs of *Abies concolor* (Gordon & Glend.) Lindl., 1/4 mi SW of Cow Creek Guard Station, Stanislaus Nat. Forest, Tuolumne Co., California, C. R. Quick 51-ak, 11.vii.1951. *Dothiorellina* Bubak is nom. dub. according to Sutton Mycol. Pap. 141, 1977. See Farr et al., 1989.

Echidnodes asterinearum Petr. & Cif.
Ann. Mycol. 28:381. 1930. **ISOTYPE** UC 801122. On *Asterina* sp. on leaves of *Eugenia* sp., Haina, Dominican Republic, R. Ciferri, 27.ii.1926. G. Samuels, New Zealand D.S.I.R. Bull. no. 230, 3: 187. 1983, lists collection date as 27.i.1926, contrary to our label and protologue, which lists Ciferri 1051 p. p., missing from our label; 27.ii.1926 seems to be correct.

Elaphomyces verrucosus C. W. Dodge
Ann. Mycol. 27:171. 1929. **HOLOTYPE** UC 126112. Under *Quercus agrifolia* Née, Berkeley, Alameda Co., California, N. L. Gardner 268, 22.ii.1905.

Elasmomyces russuloides Setch.
J. Mycol. 13:240. 1907. **LECTOTYPE** UC 221826. Under *Quercus agrifolia* Née, Univ. of California campus, Berkeley, Alameda Co., California, N. L. Gardner 220, 24.xi.1904. Evidently a mixed collection; mistakenly placed in synonymy with *Arcangeliella alveolata* (Cooke & Massee) Zeller & C. W. Dodge, Ann. Missouri Bot. Gard. 22:365. 1935, on the basis of a portion of Gardner 220 in the Lloyd Herbarium (as stated, Ann. Missouri Bot. Gard. 23:621. 1936). A portion of UC 221826 was sent for Setchell by Bonar 31.i.1937 to Zeller, together with some notes from the notebook of Setchell & Gardner; Zeller [Mycologia 31:15. 1939] stated that he had received a portion of the type from Setchell and mistakenly assumed that it had been collected by Setchell on 29:iv:1905. Presumably this was the same portion referred to by Singer and Smith [Mem. Torrey Bot. Club 21(3):61. 1960] in statement "type examined," Setchell 220. Because Zeller accepted the specimen sent in 1937 as a portion of the type, we are hereby listing UC 221826 as lectotype.

Endomyces geotrichum E. E. Butler & L. J. Petersen
Mycologia 64:367. 1972. **HOLOTYPE** UC 1446904. Two strains cultured together; cultures from soils supporting growth of unidentified grasses in Puerto Rico; strain PR-11 isolated 26.vi.1967 from mixed stand of *Citrus sinensis* (L.) Osbeck and *Coffea arabica* L. near Maricao, S slope, about 761 m elev.; strain PR-47 isolated 30.vii.1967 from Sierra de Luquillo, N slope, about 457 m elev., E. E. Butler & L. J. Petersen, vi.-vii.1967. ≡ *Galactomyces geotrichum* (E. E. Butler & L. J. Petersen) Redhead & Malloch, Canad. J. Bot. 55:1701. 1977 (listed in Butler and Fogle, Mycotaxon 33:197. 1988); ≡ *Dipodascus geotrichum* (E. E. Butler & L. J. Petersen) Arx, Antonie van Leeuwenhoek J. Microbiol. Serol. 43:324. 1977. UC no. 1446901 cited in error in protologue. Teleomorph of *Geotrichum candidum* Link ex Pers.

Entyloma bellidis K. W. Krieg.
Hedwigia Beibl. 35:(145). 1896. **ISOTYPE** UC 1267645. On *Bellis perennis* L., Bielathale near Konigstein, Saxony, Germany, [K.] W. Krieger, 16.iv.1895. Krieger, Fungi Saxonici 1103a (see Lindeberg, Symb. Bot. Upsal. 16(2):32. 1954).

Epipolaeum pseudotsugae (V. P. M. Miller & Bonar) Shoemaker see *Dimeriella pseudotsugae*

Erysiphe brunneopunctata U. Braun
Mycotaxon 20:494. 1984. **ISOTYPE** UC 1138858. On *Mimulus guttatus* DC., West Panther Creek, S of Alpine Highway, Lumberyard Ranger Station area, El Dorado Nat. Forest, Amador Co., California, C. R. Quick 54-D17, 22.ix.1954. California Fungi 1025, as *E. cichoracearum* DC.

Erysiphe californica U. Braun
Mycotaxon 20:492. 1984. **ISOTYPE** UC 695796. On *Eriogonum blissianum* H. Mason, courtyard, Life Sciences Building, Univ. of California campus, Berkeley, Alameda Co., California, L. Bonar, 13.ix.1944. California Fungi 630, as *E. cichoracearum* DC. Host hybrid *Eriogonum giganteum* S. Watson X *E. arborescens* Greene.

Erysiphe cichoracearum DC. var. **latispora** U. Braun
Mycotaxon 18:117. 1983. **ISOTYPE** UC 1272316. On *Helianthus grosseserratus* Mart., Faville Prairie Preserve, near Lake Mills, Jefferson Co., Wisconsin, H. C. Greene 3007, 31.viii.1963.

Erysiphe greeneana U. Braun
Mycotaxon 19:380. 1984. **ISOTYPE** UC 155687. On *Parietaria pensylvanica* Muhl. ex Willd., Stockton, Rooks Co., Kansas, E. Bartholomew, 15.viii.1892. Ellis & Everhart's Fungi Columbiani by E. Bartholomew 1822, as *E. cichoracearum* DC.

Erysiphe sparsa U. Braun
Mycotaxon 20:495. 1984. **ISOTYPE** UC 690945. On *Acalypha virginica* L., Madison, Dane Co., Wisconsin, H. C. Greene 775, 17.x.1944. Originally labelled *E. cichoracearum* DC.

Erysiphe thesii L. Junell
Svensk Bot. Tidskr. 61 (1):216. 1967. **ISOTYPE** UC 728277. On *Thesium humile* Vahl, Hainburger Mt., Edelstal, Niederösterreich, Austria, F. Beer, comm. J. Baumler, ix.1901. Cryptogamae Exsiccatae editae a Museo Hist. Natur. Vindobonensi 132d (issued as *E. communis* [Wallr.] Link).

Everniastrum pseudonepalense (Hale & M. Wirth) Hale ex Sipman see *Parmelia pseudonepalensis*

Exosporina fawcettii E. E. Wilson
Hilgardia 17:427. 1947. **LECTOTYPE** UC 733900. On bark of *Juglans regia*

L. (Persian walnut), Visalia, Tulare Co., California, E. E. Wilson, 21.v.1946. Packet labelled type; protologue included other hosts (*Castanea sativa* Mill., *Citrus limon* [L.] Burm. f., *C. grandis* [L.] Osbeck, and *C. sinensis* [L.] Osbeck). *Scytalidium* state of *Hendersonula toruloidea* Nattras, according to Sigler & Carmichael, 1976, Mycotaxon 4:401. Also see Wilson, 1949, Phytopathology 39:340-346. UC 733900 here designated as lectotype.

Furcaspora pinicola Bonar
Mycologia 57:391. 1965. **HOLOTYPE** UC 1272189. On fallen needles of *Pinus monophylla* Torr. & Frém., Arboretum, Inst. of Forest Genetics, Placerville, El Dorado Co., California, P. D. Gardner, 22.x.1949.

Fusicladium gnaphaliatum Bonar
Mycologia 57:392. 1965. **HOLOTYPE** UC 532308. Parasitic on leaves of *Gnaphalium stramineum* Kunth (as *G. chilense* Spreng.), Lake Merced, San Francisco, San Francisco Co., California, L. Bonar, 9.ix.1934.

Fusicladium photinicola R. L. McClain
Phytopathology 15:181. 1925. **HOLOTYPE** UC 233394. On *Heteromeles arbutifolia* (Lindl.) M. Roem., Berkeley, Alameda Co., California, R. L. McClain, ix.1923. ≡ *Spilocaea photinicola* (R. L. McClain) M. B. Ellis, 1976, p. 112.

Fusicladium poricola Bonar
Mycologia 57:393. 1965. **HOLOTYPE** UC 1272179. On pore surface of *Phellinus ferrea* (Pers.) Bourdot & Galzin, on logs of *Alnus* sp., Van Duzen River, Humboldt Co., California, H. E. Parks 2726, 31.iii.1931. California Fungi 1251.

Fusoma rubricosa Dearn. & Barthol. in Dearn.
Mycologia 9:361. 1917. **ISOTYPE** UC 1458348. On *Calamagrostis scabra* Presl, Lake Grinnell, Glacier Nat. Park, Glacier Co., Montana, E. T. Bartholomew, 26.viii.1915. Fungi Columbiani--E. Bartholomew 5019; ≡ *Mastigosporium rubricosum* (Dearn. & Barthol.) Nannf. in Lundell & Nannf., Fungi Exsiccati Suecici Praesertim Upsalienses, fasc. XVII-XVIII, Schedae, Uppsala, 1939 (see Svensk Bot. Tidskr. 65:45. 1971.)

Galactomyces citri-aurantii E. E. Butler in E. E. Butler, D. Fogle & M. Miranda
Mycotaxon 33:200. 1988. **HOLOTYPE** UC 1475056. Isolates from orange orchards (*Citrus sinensis* [L.] Osbeck presumably), one mating type (A-1, isolate 220), from vicinity of Harare [Salisbury], Zimbabwe, one mating type (A-2, isolate 178) from Tulare Co., California, USA, collector and date not indicated.

Galactomyces geotrichum (E. E. Butler & L. J. Petersen) Redhead & Malloch see *Endomyces geotrichum*

Gautieria parksiana Zeller & C. W. Dodge in Zeller
Mycologia 14:196. 1922. **ISOTYPE** UC 217741. Boys' Outing Farm, Saratoga, Santa Clara Co., California, H. E. Parks 441, 22.iii.1919. Protologue listed type as Parks Herb. 441, Zeller Herb. 1678, and Dodge Herb. 1496. In 1934, Dodge & Zeller (Ann. Missouri Bot. Gard. 21: 706) indicated that the type was in Zeller and Dodge Herbaria. Fogel and Fogel, Mycotaxon 4:291. 1976, listed Zeller 1678 as an isotype in accordance with the label of the packet at NY. This packet might be more appropriately designated the lectotype, judging from a notation with Parks 441 at FH kindly sent by Emily W. Wood, suggesting that the actual description was being prepared by Zeller (pers. comm.).

Geaster limbatus Fr. var. ***pacificus*** Morse
Mycologia 33:139. 1941. **HOLOTYPE** UC 506573. Under *Juniperus* hedge,

Berkeley, Alameda Co., California, E. Morse, 30.i.1933 on specimen (error for 1934?, after "autumn rains in 1933"), syn. of *Geastrum rufescens* Pers., according to Ponce de Léon (Fieldiana: Bot. 31:320. 1968; *Geaster limbatus* Fr. listed as a syn. of *Geastrum coronatum* Pers.).

Genea gardneri Gilkey

Univ. Calif. Publ. Bot. 6: 343 (see 300 also). 1916. **HOLOTYPE** UC 221920, **ISOTYPE** UC 511624. Under *Quercus*, on top of ground under leaves, Piedmont Park, Oakland, Alameda Co., California, N. L. Gardner 97, 4.iv. 1903.

Genea harknessii Gilkey

Univ. Calif. Publ. Bot. 6:343 (also see 301). 1916. **HOLOTYPE** UC 511631. Strawberry Canyon, Berkeley, Alameda Co., California, N. L. Gardner 429, 27.iii.1915.

Geopora magnifica Gilkey

Univ. Calif. Publ. Bot. 6:346 (also see 334). 1916. **HOLOTYPE** UC 511630. Moraga Ridge, Alameda Co., California, A. A. Baroteau, 24.i.1915 (N. L. Gardner no. 412), syn. of *Geopora cooperi* Harkn. f. *cooperi*, according to Burdsall (Mycologia 60:513. 1968).

Gloeosporium limetticola R. E. Clausen

Phytopathology 2:231. 1912. **LECTOTYPE** UC 302386. On twig of *Citrus medica* L. var. *acida* Hook. (sour lime), inoculated 30.i.1912 (Exper. XV), Berkeley, Alameda Co., California; original source of infected material, Herradura, Cuba (Earle). = *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc. in Penz. (see Farr et al., 1989). Packet from Exper. XV marked "Lime type" by Clausen is here designated as lectotype; lemon (Exper. XXVII) and Cuban lime material included in UC 302386 packet, marked "type material." Published as *G. limetticolum*, an orthographic error.

Gomphus bonarii (Morse) Singer see *Cantharellus bonarii*

Gomphus bonarii (Morse) Singer f. ***wilkinsae*** (Morse) R. H. Petersen see *Cantharellus wilkinsae*

Guignardia alaskana M. Reed

Univ. Calif. Publ. Bot. 1:161. 1902. **LECTOTYPE** UC 48589. On *Prasiola borealis* M. Reed, Iliuliuk, Unalaska, Aleutian Islands, Alaska, W. A. Setchell (Alaska no. 4021) with A. A. Lawson, vi-viii.1899. ≡ *Laestadia alaskana* (M. Reed) Sacc. & D. Sacc., Syll. Fungorum 17:576. 1905; = *Kohlmeyera complicatula* (Nyl.) S. Schatz, Mycologia 72:114. 1980. We are hereby designating UC 48589 as lectotype [packet marked type in Setchell's handwriting].

Guignardia irritans Setch. & Estee in Estee

Univ. Calif. Publ. Bot. 4:311. 1913. **LECTOTYPE** UC 173497. Parasitic on *Halidrys dioica* N. L. Gardner, San Pedro, Los Angeles Co., California, N. L. Gardner, 27.ix.1911. ≡ *Haloguignardia irritans* (Setch. & Estee) Cribb & J. W. Cribb, Univ. Queensland Dept. Bot. Pap. 3:98. 1956. Cribb & J. W. Cribb made new combination on basis of illustration. Lectotype here designated; it was marked type material in Setchell's handwriting. S. P. Monks collection was also cited; the alga was *Cystoseira*.

Gymnomyces parksii Singer & A. H. Sm.

Mem. Torrey Bot. Club 21(3):55. 1960. **ISOTYPE** UC 221961. Los Gatos, Santa Clara Co., California, H. E. Parks 477, 1919. Annotated as this species by H. Saylor, 1984. Parks 477 also cited for *Arcangeliella alveolata* (Cooke & Massee) Zeller & C. W. Dodge in Ann. Missouri Bot. Gard. 23:620. 1936.

Gymnosporangium connersii Parmelee
Canad. J. Bot. 43:245. 1965. **ISOTYPE** UC 1473379. On *Juniperus horizontalis* Moench, Cap Martin, about 3 mi SW Ste. Anne de la Pocatière, Kamouraska Co., Quebec, Canada, J. A. Parmelee 519 with I. L. Conners, 15.v.1957. Ex DAOM no. 75212. Protologue does not include names of collectors or dates.

Haloguignardia irritans (Setch. & Estee in Estee) Cribb & J. W. Cribb see *Guignardia irritans*

Humicola grisea Traaen var. **thermoidea** Cooney & R. Emers.
Cooney & Emerson, 1964, p. 79. **HOLOTYPE** UC 1206523. On elephant dung, Fleishhacker Zoo, San Francisco, San Francisco Co., California, Cooney & Emerson cult. no. 48-1, 1948.

Humicola insolens Cooney & R. Emers.
Cooney & Emerson, 1964, p. 79. **HOLOTYPE** UC 1206524. Cultured from retting guayule shrub (*Parthenium argentatum* A. Gray), California, P. J. Allen, J. Naghski, & S. R. Hoover cult. no. 3HF, 1943? See J. Bacteriol. 47:562. 1944.

Hyaloscypha strobilicola Huhtinen var. **parvispora** Huhtinen
Karstenia 29:172.1990 (1989). **ISOTYPE** 1269860. On old cone scales of *Pinus lambertiana* Douglas, beside State Highway 120, western part of Yosemite National Park, Tuolumne-Mariposa Co. line, California, L. Bonar, 11.v.1962.

Hyaloscypha strobilicola Huhtinen var. **strobilicola**
Karstenia 29:170. 1990 (1989). **ISOTYPE** UC 1466115. On old fallen cone scales of *Pinus sabiniana* Douglas, on open grassy slope with *Arctostaphylos*, 5 mi W of Grass Valley on State Highway 20, elev. 2500 ft, Nevada Co., California, I. Tavares 1656 with E. McLaughlin, 7.xi.1964.

Hydnocystis californica Gilkey
Univ. Calif. Publ. Bot. 6:343 (also see 289). 1916. **HOLOTYPE** UC 126148. Ingleside, San Francisco Co., California, N. L. Gardner 127, 2.v.1903. = *Hydnocystis clausa* (Tul. & C. Tul.); see Ceruti, 1960, p. 12.

Hydnotrya ellipsospora Gilkey
Univ. Calif. Publ. Bot. 6:344 (also see 307). 1915. **HOLOTYPE** UC 511628. Under *Quercus agrifolia* Née, Pacific Grove, Monterey Co., California, N. L. Gardner 316 with M. B. Nichols, xii.1909.

Hygrophorus subbasidiosus Largent
Mycotaxon 23:383. 1985. **HOLOTYPE** UC 605287. N of Life Sciences Building, Univ. of California campus, Berkeley, Alameda Co., California, V. P. M. Miller, 6.i.1939.

Hyponectria gregaria M. E. Barr
Mycologia 69:961. 1977. **ISOTYPE** UC 1473382. On *Ericameria Bloomeri* (A. Gray) J. F. Macbr. (as *Chrysothamnus bloomeri* [Gray] Greene var. *angustatus* Gray), ridge N of Horse Camp, Mt. Shasta, Siskiyou Co., California, W. B. Cooke 20482, 28.viii.1947. Ex DAOM no. 124064. Given herbarium name *Discosphaerina aplopappi* by Wehmeyer but not bitunicate, according to Barr.

Hyponectria mohavensis Bonar
Mycologia 57:381. 1965. **HOLOTYPE** UC 1272176. On *Yucca brevifolia* Engelm., 3.5 miles S of Victorville along U. S. Highway 66, San Bernardino Co., California, L. Bonar, 4.iv.1952. California Fungi 1262. Hypocreaceous; not *Hyponectria*, according to Barr, Mycologia 69: 958. 1977.

Hypoxylon atropurpureum (Fr.: Fr.) Fr. see *Sphaeria atropurpurea*

Hypoxylon vogesiacum Pers. ex Sacc.
Syll. Fungorum 1:380. 1882. **ISOTYPE** UC 958952. On wood of *Acer pseudoplatanus* L., Vosgesen (region of Vosges Mts., Rhineland), France, Mougeot & Nestler, Stirpes Cryptogamae Vogeso-Rhenanae 765 (1823); see Miller, Mycologia 25:326. 1933.

Hysterangium fischeri Zeller & C. W. Dodge
Ann. Missouri Bot. Gard. 16:109. 1929. **HOLOTYPE** UC 126125. Under *Quercus* and *Eucalyptus*, Berkeley, Alameda Co., California, W. A. Setchell 258 with C. C. Dobie (number series same as that for N. L. Gardner), 12.ii.1905. Annotated by M. A. Castellano as syn. of *H. gardneri* E. Fisch., 1989. According to protologue, holotype is in UC.

Hysterium pinastri Schrad.: Fr.
(Syst. Mycol. 2:587. 1826 [1821])
Mitt. Bundesforschungsanst. Forst-Holzw., Reinbek 108:80 (Proc. 5th European Colloq. Forest Pathologists: 80). 1975. **NEOTYPE** UC 1457959 (portion of UC 960775). On dead needles of *Pinus*, Mougeot & Nestler, Stirpes Cryptogamae Vogeso-Rhenanae 76 (1810). Neotype designated by J. M. Staley; ≡ *Lophodermium pinastri* (Schrad.: Fr.) Chevall., (Flore de Paris 1:436. 1826).

Janetia bonarii (M. B. Ellis) S. Hughes see *Sporidesmium bonarii*

Janetia garryae (Bonar) S. Hughes see *Sporidesmium garryae*

Kabatiella phoradendri (L. Darling) J. M. Harvey see *Protocoronospora phoradendri*

Kabatiella phoradendri (L. Darling) J. M. Harvey f. ***umbellulariae*** J. M. Harvey
Madroño 11:170. 1951. **HOLOTYPE** UC 924306. On *Umbellularia californica* Nutt., N side of Russian River, 1 mi W of Monte Rio, Sonoma Co., California, John M. Harvey, 15.xi.1949. ≡ *Aureobasidium umbellulariae* (J. M. Harvey) Herm.-Nijhof, Stud. Mycol. 15:141. 1977.

Kalmusia pinicola Bonar
Mycologia 57:386. 1965. **HOLOTYPE** UC 1272190. On fallen needles of *Pinus sabiniana* Douglas, Sutter's Mill Site, Marshall Gold Discovery State Park, Coloma, El Dorado Co., California, L. Bonar, 16.iv.1962. California Fungi 1268.

Kellermania yuccifoliorum A. W. Ramaley
Mycotaxon 47:262-263. 1993. **HOLOTYPE** UC1475101. On leaves of *Yucca brevifolia* Engelm., near mi 20, Gem Acres Road turnoff from U. S. Highway 40, Mohave Co., Arizona, A. W. Ramaley 9208, 15.iv.1992. Anamorph of *Planistromella yuccifoliorum*.

Laestadia alaskana (M. Reed) Sacc. & D. Sacc. see *Guignardia alaskana*

Lecanora christoi W. A. Weber *LICHEN*
Bryologist 78:206. 1975. **ISOTYPE** UC 1456387. Sandstone ridge, W side of Rifle Creek, 8 km N of Rifle, Garfield Co., Colorado, W. A. Weber, G. Kunkel & J. Munger, 12.vi.1974. Lichenes Exsiccati distributed by the Univ. of Colorado Museum 458.

Lecanora rediunta Stizenb. in Hasse *LICHEN*
Bull. Torrey Bot. Club 24:446. 1897. **LECTOTYPE** UC 52938. On *Heteromeles*, Santa Catalina Island, Los Angeles Co., California, H. E. Hasse, i.1895. ≡ *Schismatomma rediunta* (Hasse) Tehler, Lichenologist 17:211. 1985 (lectotype selected p. 211).

Lecanora thamnitis Tuck. *LICHEN*
Tuckerman, 1866, p. 20. **ISOLECTOTYPE** UC 666785. Sandstone rocks, Oakland Hills, Alameda Co., California, H. N. Bolander s.n., undated. Lectotype (Reliquiae Tuckermanianae 116 [FH]) selected by Ryan,

Mycotaxon 34:699, 1989. UC specimen annotated as isolectotype by B. Ryan; ≡ *Cladidium thamnitis* (Tuck.) Hafellner, Beih. Nova Hedwigia 79:296. 1984; = *Cladidium bolanderi* (Tuck.) B. D. Ryan, Mycotaxon 34:699. 1989.

Lecidea purpurascens Vain. *LICHEN*
Univ. Calif. Publ. Bot. 12:10. 1924. **ISOTYPE** UC 262705. On tree bark in Punaruu Valley, Punauia Distr., Tahiti, Society Islands, W. A. Setchell (Tahiti no. 5380, in part) with H. E. Parks, 15.vi.1922. Original spelling of *L. purpurescens* was orthographic error; ≡ *Phyllopsora purpurascens* (Vain.) Zahlbr., Catalogus Lichenum Universalis 4:401. 1927. Annotated as syn. of *P. societatis* (Vain.) Zahlbr. by L. Brako, 1987, according to R. Alava (personal correspondence).

Lecidea societatis Vain. *LICHEN*
Univ. Calif. Publ. Bot. 12:10. 1924. **ISOTYPE** UC 261077. On tree bark, Papehue River, Paea Distr., Tahiti, Society Islands, W. A. Setchell (Tahiti no. 5349) with H. E. Parks, 9.vi.1922. ≡ *Phyllopsora societatis* (Vain.) Zahlbr., Catalogus Lichenum Universalis 4:401. 1927. Annotated as holotype by L. Brako, 1987 (personal correspondence from R. Alava).

Lecidea suberratica J. Lowe *LICHEN*
Lloydia 2:280. 1939. **ISOTYPE** UC 1459952. On rock under stump in area burned about 25 years earlier, Newcomb, Adirondacks, Essex Co., New York, J. L. Lowe 6021, 4.viii.1934. = *Micarea erratica* (Korb.) Hertel, Rambold & Pietschm. in Rambold, 1989, Biblioth. Lichenol. 34:227.

Lecidea vicosensis Herre *LICHEN*
Madroño 5:235. 1940. **HOLOTYPE** UC 510550. On bark, Fazenda de Aguada, Agricultural College Land, Viçosa, State of Minas Geraes, Brazil, Ynez Mexia 4925a, 31.vii.1930. Publication erroneously gives collection no. as 4295a.

Lepidoderma aggregatum Kowalski
Mycologia 63:511. 1971. **ISOTYPE** UC 1408496. On living twigs, 16 mi E of Glacier, elev. 4000 ft, Whatcom Co., Washington, D. T. Kowalski 8870, 16.vi.1968. Publication lists types in UC and DTK (now at CHSC); CHSC specimen here designated as lectotype.

Lepidoderma didermoides Kowalski
Mycologia 63:503. 1971. **ISOTYPE** UC 1408491. 18 mi E of Glacier, Mt. Baker, elev. 4050 ft, Whatcom Co., Washington, D. T. Kowalski 10580, 22.vi.1970. Publication lists types in UC and DTK (now at CHSC); CHSC specimen here designated as lectotype.

Leptographium wageneri (W. B. Kendr.) M. J. Wingf. var. **ponderosum** (T. C. Harr. & F. W. Cobb) T. C. Harr. & F. W. Cobb see *Verticicladiella wageneri* W. B. Kendr. var. *ponderosa* T. C. Harr. & F. W. Cobb

Leptographium wageneri (W. B. Kendr.) M. J. Wingf. var. **pseudotsugae** T. C. Harr. & F. W. Cobb
Mycotaxon 30:501. 1987. **HOLOTYPE** UC 1475052, **ISOTYPE** UC 1475086. Isolated from *Pseudotsuga menziesii* (Mirb.) Franco, Union Valley Reservoir, El Dorado Co., California, T. C. Harrington, vii.1980. Dried culture of ATCC 64196.

Leptosphaeria lasioderma Ellis & Everh.
Proc. Acad. Nat. Sci. Philadelphia 45:135. 1893. **ISOTYPE** UC 405069. On *Artemisia tridentata* Nutt., Sprucemont, Elko Co., Nevada, M. E. Jones, 31.x.1892. ≡ *Dothidotthia lasioderma* (Ellis & Everh.) M. E. Barr, Mycotaxon 34:523. 1989. Printed on label is "n. sp. type."

Collector, date, and elevation in protologue are M. E. Jones no. 2, October, 1892, 8500 ft altitude.

Leptosphaeria occidentalis Ellis & Everh.
Erythea 2:20. 1894. **ISOTYPES** UC 152870, UC 44799. On dead *Echinochloa crusgalli* (L.) Beauv., Rockport, Rooks Co., Kansas, E. Bartholomew, iv.1893. Ellis & Everhart Fungi Columbiani 119 (UC 44799); North American Fungi, second series, 2925 (UC 152870; 2925 cited by Barr, Mycotaxon 34:514. 1989, as isotype); ≡ *Phaeosphaeria occidentalis* (Ellis & Everh.) Shoemaker, Canad. J. Bot. 67:1572. 1989; = *Chaetomastia typhicola* (P. Karst.) M. E. Barr, Mycotaxon 34:514. 1989. Host given originally as (syn.) *Panicum crus-galli*, collection Bartholomew 986.

Leptosphaeria personata Niessl apud Rabenh.
Rabenhorst's Fungi Europaei Exsiccati, ser. 2, no. 1933, 1875; Bot. Jahrb. Syst. 3: 262. (1875)1877. **ISOTYPE** UC 469314. On *Deschampsia caespitosa* (L.) Beauv., Steiermark, Oberösterreich, Austria, Niessl, coll. date not indicated. Specimen without exsiccati label; handwritten label: *Leptosphaeria elegans* n. s. auf *Aira caespitosa* Voitsberg; 9 Ju may be what precedes N. (presumably Niessl's initial). In another handwriting, added: Steiermark, Original Niessl's; *elegans* is crossed out and *personata* written over it); ≡ *Leptosphaerulina personata* (Niessl) M. E. Barr, Contr. Univ. Michigan Herb. 9:542. 1972; ≡ *Scleropleella personata* (Niessl) Hohn., Ann. Mycol. 16:158. 1918, type species (see Holm, Symb. Bot. Upsal. 14[3]:171. 1957; also see Crane & Shearer, Bull. Illinois Nat. Hist. Surv. 34:262. 1991).

Leptosphaerulina personata (Niessl) M. E. Barr see *Leptosphaeria personata*

Leucostoma sequoiae Bonar
Mycologia 20:295. 1928. **HOLOTYPE** UC 469596. On dead twigs of *Sequoia sempervirens* (D. Don) Endl., Mill Valley, Marin Co., California, L. Bonar, 20.v.1923.

Licea applanata Kowalski see *Licea deplanata*

Licea deplanata (Kowalski) Kowalski
Madroño 21:455. 1972. **ISOTYPE** UC 1408278. William's Ranch, 6 mi N of Chico, Butte Co., California, D. T. Kowalski 10000, 16.iv.1969, nom. nov. for *Licea applanata* Kowalski, Mycologia 62:1058. 1970 (non *L. applanata* Berk., London J. Bot. 4:67. 1845); Type material was deposited in several herbaria, according to Kowalski, 1970; his own herbarium specimen (now in CHSC) is here designated as lectotype.

Licea hepatica Kowalski
Mycologia 64:359. 1972. **ISOTYPE** UC 1445506. Cayuse Pass, Mt. Rainier Nat. Park, elev. 4700 ft, Pierce Co., Washington, D. T. Kowalski 10910, 18.vi.1970. CHSC specimen here designated as lectotype. Specimen label gives date of 25.vi.1970 for no. 10910.

Limacinia lithocarpi V. P. M. Miller & Bonar
Univ. Calif. Publ. Bot. 19:409. 1941. **HOLOTYPE** UC 498808. On *Lithocarpus densiflora* (Hook. & Arn.) Rehder, Inverness ridge, Marin Co., California, L. Bonar, 21.ii.1932. ≡ *Scolecobonaria lithocarpi* (V. P. M. Miller & Bonar) Bat., Sydowia Beih. 3:98. 1962. Error in original publication: on page 409 ";" after "498808" should have been "," and "," after "3573" should have been ";"; Parks 3573, UC 617323 is holotype of *Protopeltis lithocarpi*.

Limacinia multiseptata M. E. Barr
Canad. J. Bot. 33:507. 1955. **HOLOTYPE** UC 276037. On *Arctostaphylos*, Zig Zag Fire Trail, Mt. Tamalpais, Marin Co., California, H. E. Parks

s. n., 21.iii.1926. ≡ *Ophiocapnocoma multiseptata* (M. E. Barr) Bat. & Cif., Saccardoa 2:168. 1963; = *O. phloiophilia* (E. E. Fisher) S. Hughes, New Zealand J. Bot. 5:120. 1967.

Lophodermium pinastri (Schrad.: Fr.) Chevall. see *Hysterium pinastri*

Macowanites magnus Parks in Zeller & C. W. Dodge
Ann. Missouri Bot. Gard. 22:369. 1935. **LECTOTYPE** UC 221982. Aldercroft, Los Gatos Canyon, Santa Clara Co., California, H. E. Parks 208, 13.x.1918. ≡ *Arcangeliella magna* (Parks) Zeller, Mycologia 40:643. 1948. Type in UC (Ann. Missouri Bot. Gard. 23:637. 1936). Protologue gave locality as Call-of-the-Wild, which is nearby in Los Gatos Canyon; in protologue, types said to be in UC, Dodge (FH; pers. comm. from Emily W. Wood), and Zeller Herbaria (NY).

Marasmiellus pigmentatus (Bliss) Singer see *Omphalia pigmentata*

Marssonia galii Solheim
Univ. Wyoming Publ. Sci., Bot. 1:230. 1934. **ISOTYPE** UC 653056. On leaves of *Galium asperrimum* A. Gray, Miller Peak, Huachuca Mountains, Cochise Co., Arizona, L. N. Goodding 2420, 22.viii.1907. Mycoflora Saximontanensis Exsiccata 92. *Marsonia* on label. Correct genus name is *Marssonina*, but new combination not yet made, according to Farr et al., 1989.

Marssonia wyethiae Ellis & Everh.
Proc. Acad. Nat. Sci. Philadelphia 46:373. 1894. **ISOTYPES** UC 44835, UC 44836. On *Wyethia glabra* A. Gray, Santa Rosa, Sonoma Co., California, W. C. Blasdale, 25.v.1894. ≡ *Didymaria wyethiae* (Ellis & Everh.) Solheim, Univ. Wyoming Publ. 36:64. 1970; see Mycotaxon 10:53. 1979; ≡ *Pseudodidymaria wyethiae* (Ellis & Everh.) U. Braun, Cryptog. Bot. 4:110. 1993 (UC 44835, printed label form marked n. sp. with data written in ink; UC 44836, Ellis and Everhart Fungi Columbiani 589, dated May 1894).

Martellia californica Singer & A. H. Sm.
Mem. Torrey Bot. Club 21(3):33. 1960. **ISOTYPE** UC 296330. Guadeloupe Mines, Santa Clara Co., California, H. E. Parks 524, 9.iv.1919. According to Singer & Smith, Zeller identified type material as *Arcangeliella pilosa* but later called it *A. cremea*.

Martellia scissilis (Zeller & C. W. Dodge) Singer & A. H. Sm. see *Arcangeliella scissilis*

Mastigosporium rubricosum (Dearn. & Barthol.) Nannf. in Lundell & Nannf. see *Fusoma rubricosa*

Meliola bonarii Bat. & Nascim.
Anais Soc. Biol. Pernambuco 15:458. 1957. **HOLOTYPE** UC 211351. On *Adina*, Taytay, Palawan (Island and Prov.), Philippines, E. P. Merrill 8882, May 1913.

Microallomyces dendroideus R. Emers. & J. A. Robertson
Amer. J. Bot. 61:309. 1974. **HOLOTYPE** UC 1445834. Cult. CR74 isolated from soil collected near Santa Clara NW of Quesada, Alajuela Province, Costa Rica, R. Emerson 51, 14.ii.1957.

Mucor miehei Cooney & R. Emers.
Cooney & Emerson, Thermophilic Fungi, 1964, p. 26. **HOLOTYPE** UC 1206519. On retting guayule shrub (*Parthenium argentatum* A. Gray), California, C. B. van Niel cult. 21, isolated 1944; subculture xii.1961.

Mycocalicium sequoiae Bonar
Madroño 21:68. 1971. **HOLOTYPE** UC 1403569. On exudate from charred, exposed heartwood of living *Sequoiadendron giganteum* (Lindl.) J. Buchholz, Crescent Meadow, Giant Forest, Sequoia Nat. Park, Tulare

Co., California, L. Bonar, 1.vii.1935. California Fungi 1380.

Mycophycophila polyporolithi Bonar
Mycologia 57:379. 1965. **HOLOTYPE** UC 1272162. On *Polyporolithon conchatum* (Setch. & M. H. Foslie) L. R. Mason, Cypress Point, Pacific Grove, Monterey Co., California, B. M. Nichols 636, xii.1910.
≡ *Chadefaudia polyporolithi* (Bonar) Kohlm., Bot. Mar. 16:205. 1973.

Mycosphaerella sequoiae Bonar
Mycologia 34:184. 1942. **HOLOTYPE** UC 653844. On leaves and young twigs of *Sequoia sempervirens* (D. Don) Endl., Trinidad, Humboldt Co., California, H. E. Parks, spring, 1932 (publ. as type and marked "type" in Bonar's handwriting). California Fungi 651. Trinidad collection 1.ii.1933 cited is California Fungi 652.

Myriococcum albomyces Cooney & R. Emers.
Cooney & Emerson, Thermophilic Fungi, 1964, p. 60. **HOLOTYPE** UC 1206515. Cultured from straw litter of chicken nest, Reno, Washoe Co., Nevada, D. G. Cooney cult. 5 isolated in 1950; subculture 1961.

Myxosporella ulmicola Bonar
Mycologia 59:599. 1967. **HOLOTYPE** UC 1318860. At ends of dead twigs of *Ulmus americana* L., Fort Hill Farm near Burlington, Mineral Co., West Virginia, L. Bonar, 5.vii.1963. Publ. as 3.vii.1963.

Myxosporella venicola Bonar
Mycologia 57:390. 1965. **HOLOTYPE** UC 640700. On leaves of *Salix hookeriana* Hook. (as *S. piperi* Bebb), Fortuna, Humboldt Co., California, J. P. Tracy 12204, 19.v.1933. Not listed in Farr et al., 1989.

Nectria penicillioides Ranzoni
Amer. J. Bot. 43:17. 1956. **HOLOTYPE** UC 978993. Isolated from submerged decaying *Acer* leaves, Green Valley Falls, Solano Co., California, F. V. Ranzoni, 13.ii.1954.

Neovossia opaca (Syd. & P. Syd.) Vánky see *Tilletia opaca*

Neovossia pulcherrima (Ellis & Galloway ex G. P. Clinton) Vánky see *Tilletia pulcherrima*

Oligoporus sequoiae (Bonar) Gilb. & Ryvarden see *Poria sequoiae*

Omphalia pigmentata Bliss
Mycologia 30:319. 1938. **ISOTYPE** UC 568872. On leaf bases of *Phoenix dactylifera* L., Citrus Exper. Station, Riverside, Riverside Co., California, D. E. Bliss, 28.viii.1935. Also on *Washingtonia filifera* H. Wendl.; ≡ *Marasmiellus pigmentatus* (Bliss) Singer, Lilloa 22:300. 1951. Singer later concluded that this taxon does not belong in *Marasmiellus* (Beih. Nova Hedwigia 44:319. 1973).

Omphalia tralucida Bliss
Mycologia 30:325. 1938. **LECTOTYPE** UC 568873. On leaf bases of *Washingtonia filifera* H. Wendl., Riverside, Riverside Co., California, D. E. Bliss, 19.viii.1935; labelled type material; also coll. viii.1937 (UC 568874). Farr et al., 1989, reported type missing; therefore UC 568873 is designated as lectotype.

Ophiocapnocoma multiseptata (M. E. Barr) Bat. & Cif. see *Limacinia multiseptata*

Ophiostoma radicicola (Bliss) Arx see *Ceratostomella radicicola*

Ophiostoma wageneri see *Ceratocystis wageneri*

Papulaspora aspera Bernhardt & Duniway
Canad. J. Bot. 63:429. 1985. **HOLOTYPE** UC 1475012. From turions of *Potamogeton crispus* L., Butte Co., California, E. A. Bernhardt & J. M. Duniway, 12.ii.1981. Dried agar cult. of isolate no. feb 12-81-5. Protologue lists incorrect UC no. 147012.

Parmelia pseudonepalensis Hale & M. Wirth *LICHEN*
Phytologia 22:40. 1971. **ISOTYPE** UC 1317827. Wood Station, km 87, State of Morelos, Mexico, C. G. Pringle 10713, 4.vi.1904 (Plantae Mexicanae, labelled *P. cirrhata*; bearing COLO no. S 19,203). ≡ *Everniastrum pseudonepalense* (Hale & M. Wirth) Hale ex Sipman, Mycotaxon 26:242. 1986; ≡ *Cetrariastrum pseudonepalense* (Hale & M. Wirth) W. C. Culb. & C. F. Culb., Bryologist 84:303. 1981.

Pezizella aristospora Bonar
Mycologia 34:183. 1942. **HOLOTYPE** UC 653847. On dead leaves and twigs of *Sequoiadendron giganteum* (Lindl.) J. Buchholz, Tuolumne Grove, Yosemite National Park, Tuolumne Co., California, L. Bonar, 23.vii.1933. California Fungi 660; ≡ *Ceratophacidium aristosporum* (Bonar) J. Reid & Piroz., Canad. J. Bot. 44:645. 1966.

Phaeochaetia arbutifoliae Bat., Cif., & Nascim.
Sydowia Beih. 3:64. 1962. **HOLOTYPE** UC 756704. On *Heteromeles arbutifolia* (Lindl.) M. Roem., between Knights and Alexander Valley, Sonoma Co., H. E. Parks 3622, 20.iv.1931. = *Vertixore atronitidum* V. P. M. Miller & Bonar; according to Reynolds, Mycotaxon 14:202. 1982, apparently belonging to *Chaetothyrium.*

Phaeosaccardinula dematia V. P. M. Miller & Bonar
Univ. Calif. Publ. Bot. 19:411. 1941. **HOLOTYPE** UC 617322. On *Baccharis pilularis* DC. ssp. *consanguinea* (DC.) C. B. Wolf, Moss Beach, San Mateo Co., California, H. E. Parks 2139, 17.iv.1924. California Fungi 661.

Phaeosphaerella rhamni Bonar
Mycologia 34:185. 1942. **HOLOTYPE** UC 653842. Parasitic on leaves of *Rhamnus californica* Eschsch., 18 Mile Creek, Smith River, Del Norte Co., California, L. Bonar & H. E. Parks, 13.vii.1933. ≡ *Venturia rhamni* (Bonar) M. E. Barr, Canad. J. Bot. 46:820. 1968.

Phaeosphaeria occidentalis (Ellis & Everh.) Shoemaker see *Leptosphaeria occidentalis*

Phialea umbellulariae E. K. Cash
Mycologia 50:652. 1958. **ISOTYPE** UC 1139301. On dead leaves of *Umbellularia californica* Nutt., Darlingtonia, Smith River, Del Norte Co., California, H. E. Parks 6093, i.1938. = *Crocicreas cyathoideum* (Bull.:Fr.) S. E. Carp. var. *cyathoideum*, Mem. New York Bot. Gard. 33:67. 1981.

Phlebia subalbida W. B. Cooke
Mycologia 48:397. 1956. **HOLOTYPE** UC 669635. On rotting log of *Abies magnifica* Andrew Murray bis (1812-1878), Gold Lake Lodge, Plumas Co., California, L. Bonar, 29.vii.1942. = *P. centrifuga* P. Karst. (see Eriksson, Hjortstam, & Ryvarden, 1981, p. 1093). Incorrect UC no. (40573) listed in protologue.

Phloeospora cercocarpi (Bonar) B. Sutton & Pollack see *Septogloeum cercocarpi*

Pholiota magnivelata Dearn. in Morse see *Cortinarius magnivelatus*

Pholiota trachyspora Clem. & E. S. Clem. apud Overholts
North American Flora 10 (4):267. 1924. **ISOTYPE** UC 156636. Sugar Loaf Park, elev. 2500 m., El Paso Co., Colorado, F. E. Clements & E. S. Clements, 13.viii.1906. Cryptogamae Formationum Coloradensium 373. 1907, spelled *Pholidota* on label. Listed in Crypt. Form. Colorad. Scheda, Gazetteer, W. A. Weber, printed New York Bot. Garden, 1972. According to Overholts, Ann. Missouri Bot. Gard. 14: 126. 1927, spores are not characteristic of *Pholiota*; he suggested a resemblance to *Cortinarius.*

Phomopsis andina Petr.
Sydowia 4:564. 1950. **ISOTYPE** UC 801100. On fallen leaves of *Cestrum* sp., Hacienda San Antonio near Baños, Tungurahua Prov., Ecuador, H. Sydow 709, 9.i.1938.

Phyllopsora purpurascens (Vain.) Zahlbr. see *Lecidea purpurascens*

Phyllopsora societatis (Vain.) Zahlbr. see *Lecidea societatis*

Phyllosticta alpinicola Solheim
Mycologia 41:625. 1949. **ISOTYPE** UC 775393. On living leaves of *Trifolium parryi* A. Gray, roadside below Brooklyn Lake, Medicine Bow Mts., Albany Co., Wyoming, W. G. Solheim 50, 16.viii.1930. Mycoflora Saximontanensis Exsiccata 454.

Phyllosticta anemonicola Sacc. & Syd. in Sacc.
Syll. Fungorum 14:865. 1899. **ISOTYPE** UC 151600. On *Anemone canadensis* L. (as *A. pennsylvanica* L.), Ann Arbor, Washtenaw Co., Michigan, H. L. Merrow, x.1893. nom. nov. for *P. anemonis* Ellis & Everh., Proc. Acad. Nat. Sci. Philadelphia 46:356. 1894, non Fuckel (Hedwigia 3:157. 1864). Ellis & Everhart Fungi Columbiani 568, with species epithet as *anemones*; North American Fungi (N.A.F.) 3152 at lower right on label.

Phyllosticta anemonis Ellis & Everh., non Fuckel see *Phyllosticta anemonicola*

Phyllosticta brunnea Dearn. & Barthol. in Dearn.
Mycologia 9:351. 1917. **ISOTYPE** UC 1464501. On leaves of *Populus angustifolia* E. James, Montrose, Montrose Co., Colorado, E. Bartholomew, 9.x.1912. Fungi Columbiani--E. Bartholomew 5040.

Phyllosticta castanicola Ellis & Everh.
Proc. Acad. Nat. Sci. Philadelphia 47:431. 1895. **ISOTYPE** UC 45026. On leaves of *Castanopsis chrysophylla* (Douglas) A. DC., Sisson (now town of Mt. Shasta), Siskiyou County, California, M. A. Howe 122, 24.vii.-10.viii.1894. ≡ *Asteromella castanicola* (Ellis & Everh.) Petr., Sydowia 11:341. 1957 (1958). Protologue gives date as July 1894, as well as Howe no. 122, with host misnamed as *Castanus*.

Phyllosticta eriogoni W. B. Cooke in W. B. Cooke & C. G. Shaw
Mycologia 44:797. 1952. **ISOTYPE** UC 976079. On *Eriogonum elatum* Douglas, Viola, near Bingen, Klickitat Co., Washington, W. N. Suksdorf 1137, 2.vi.1926. Reliquiae Suksdorfiana 39. Locality spelled Vila on label.

Phyllosticta geloniae H. S. Yates
Philipp. J. Sci., C. 13:381. 1918. **ISOTYPE** UC 364635. On leaves of *Gelonium*, Alabat Island, offshore from Quezon Prov., Luzon, Philippines, E. D. Merrill 10538, 21-30.xii.1916. Protologue gives Dec. 25, Alabat.

Phyllosticta hosackiae W. B. Cooke in W. B. Cooke & C. G. Shaw
Mycologia 44:796. 1952. **ISOTYPE** UC 976082. On *Lotus douglasii* Greene, Falcon Valley, Klickitat Co., Washington, W. N. Suksdorf 149, 11.ix.1884. Reliquiae Suksdorfiana 42. Protologue gives year as 1889.

Phyllosticta lupini Bonar
Mycologia 20:297. 1928. **LECTOTYPE** UC 469594. On leaves of *Lupinus succulentus* Koch, Tiburon, Marin Co., California, H. E. Parks, 10.iii.1923. Hereby selected as lectotype; two collections listed, but this coll. labelled as type by Bonar. California Fungi 285.

Phyllosticta phoradendri Bonar
Mycologia 34:188. 1942. **HOLOTYPE** UC 653839. On leaves of *Phoradendron macrophyllum* Cockerell on *Populus* sp., near Onyx, South Fork, Kern River, Kern Co., California, L. Bonar, 30.iii.1933.

Phyllosticta sparsa Bonar
Mycologia 20:296. 1928. **HOLOTYPE** UC 469489. On *Vaccinium ovatum* Pursh, N slope of Mt. Tamalpais, near head of Eldridge Grade, Marin Co., California, L. Bonar, 4.x.1925. = *Phyllosticta vaccinii* Earle, according to Farr et al., 1989.

Piersonia bispora Gilkey
Univ. Calif. Publ. Bot. 6:345 (also see 328). 1916. **HOLOTYPE** UC 126207, **ISOTYPE** UC 1273085. Under *Pinus radiata* D. Don, Univ. of California campus, Berkeley, Alameda Co., California, N. L. Gardner 126, 27.iv.1903. = *Choiromyces alveolatus* (Harkn.) Trappe, Mycotaxon 2:114. 1975.

Pilocarpon cateileum Vain. *LICHEN*
Univ. Calif. Publ. Bot. 12:11. 1924. **ISOLECTOTYPE** UC 261087. On *Mangifera* leaves along the Punaruu River, Punauia Distr., Tahiti, Society Islands, W. A. Setchell (Tahiti No. 5142) with H. E. Parks, 15.vi.1922. ≡ *Bacidia cateilea* (Vain.) R. Sant., Symb. Bot. Upsal. 12(1):472. 1952; lectotype selected by Santesson; ≡ *Badimia cateilea* (Vain.) Lücking, Lumbsch & Elix, Botanica Acta 107: 400. 1994.

Piptarthron pluriloculare A. W. Ramaley
Mycotaxon 42:63. 1991. **HOLOTYPE** UC 1475060. On dead leaves of *Yucca baccata* Torr., south-facing slopes below Fort Lewis College, Durango, La Plata Co., Colorado, A. W. Ramaley s. n., 5.v.1990. Protologue gives date as 28.iv.90; specimen packet marked as above by collector.

Piptarthron uniloculare A. W. Ramaley
Mycotaxon 45:451. 1992. **HOLOTYPE** UC 1475095. On dead leaves of *Yucca baccata* Torr., Smelter Mt., Durango, La Plata Co., Colorado, A. W. Ramaley 9018, 10.ii.1992. Anamorph of *Planistroma obtusilunatum*.

Piptocephalis benjaminii (Embree) R. K. Benj. see *Chaetocladium benjaminii*

Planistroma obtusilunatum A. W. Ramaley
Mycotaxon 45:450. 1992. **HOLOTYPE** UC 1475096. On dead leaves of *Yucca baccata* Torr., Fort Lewis College campus, Durango, La Plata Co., Colorado, A. W. Ramaley 9014, 4.iv.1991. Teleomorph of *Piptarthron uniloculare*.

Planistroma yuccigena A. W. Ramaley
Mycotaxon 42:69. 1991. **HOLOTYPE** UC 1475061. On dead leaves of *Yucca baccata* Torr., south-facing slopes below Fort Lewis College, Durango, La Plata Co., Colorado, A. W. Ramaley s. n., 26.ix.1990.

Planistromella uniseptata A. W. Ramaley
Mycotaxon 47:267. 1993. **HOLOTYPE** UC 1475102. On leaves of *Yucca elata* Engelm., W side of Interstate Highway 25, mi 105.4, Socorro Co., New Mexico, A. W. Ramaley 9217, 12.iv.1992. Teleomorph of *Kellermania yuccigena* Ellis & Everh., J. Mycol. 1:154. 1885.

Planistromella yuccifoliorum A. W. Ramaley
Mycotaxon 47: 261. 1992. **HOLOTYPE** UC 1202973. On leaves of *Yucca brevifolia* Engelm., 20 mi E of Baker, San Bernardino Co., California, I. Tavares 466, 14.iv.1960. Teleomorph of *Kellermania yuccifoliorum*.

Podoxyphium annonae Bat., Nascim. & Cif.
Quad. Lab. Crittog. Ist. Bot. Univ. Pavia 31:165. 1963 (Univ. Recife Publ. no. 163). **HOLOTYPE** UC 364677. On *Annona*, Membakut, Sabah, East Malaysia (formerly British North Borneo), H. S. Yates 99, x.1917.

Polypilus flettii (Pouzar) Teixeira see *Albatrellus flettii*

Poria sequoiae Bonar in E. Fritz & Bonar
J. Forest. (Washington) 29:377. 1931. **HOLOTYPE** UC 506480. On *Sequoia sempervirens* (D. Don) Endl., Weott, Humboldt Co., California, E.

Fritz, x-xi.1929. ≡ *Postia sequoiae* (Bonar) M. J. Larsen & Lombard, Mycotaxon 26:272. 1986; ≡ *Oligoporus sequoiae* (Bonar) Gilb. & Ryvarden, Mycotaxon 22:365. 1985.

Porina hibisci Vain. *LICHEN*
Univ. Calif. Publ. Bot. 12:14. 1924. **ISOTYPE** UC 261080. On *Hibiscus tiliaceus* L., from trip up the Papehue River, Paea Distr., Tahiti, Society Islands, W. A. Setchell (Tahiti No. 5131) with H. E. Parks, 7.vi.1922. Specimen in TUR-V is type collection (Alava, 1988).

Porina mangiferae Vain. *LICHEN*
Univ. Calif. Publ. Bot. 12:14. 1924. **ISOTYPE** UC 262688. On *Mangifera* leaves, Fautaua Valley, Pare Distr., Tahiti, Society Islands, W. A. Setchell (Tahiti No. 5091 in part) with H. E. Parks, 3.vi.1922. Only one collection cited; no mention in text of location of type, but Santesson listed holotype at TUR (Symb. Bot. Upsal. 12(1):223. 1952); also listed as holotype by Alava, 1988; = *Porina corruscans* (Rehm) R. Sant., Symb. Bot. Upsal. 12(1):223. 1952.

Porina perminuta Vain. *LICHEN*
Univ. Calif. Publ. Bot. 12:14. 1924. **ISOTYPE** UC 261089. On *Mangifera* leaves, Faaa District, Tahiti, Society Islands, W. A. Setchell (Tahiti No. 5085) with H. E. Parks, 1.vi.1922. ≡ *Phylloporina perminuta* (Vain.) Zahlbr., Catalogus Lichenum Universalis, 8:139. 1931, listed as syn. of *Porina perminuta* by Santesson, Symb. Bot. Upsal. 12(1):217. 1952, who gives coll. no. of holotype as 5058, which represents an alga; protologue gives it as 5085; UC 261089 is 5085, but is labelled paratype. Specimen at TUR-V listed as type collection by Alava, 1988.

Porpidia afromontana Brusse *LICHEN*
Bothalia 18:93. 1988. **ISOTYPE** UC 1570877. On basalt rock in full sun, 65 km N of Maclear, Cape Prov., South Africa, F. Brusse 4590, 26.i.1986. Deposition in UC indicated in text.

Postia sequoiae (Bonar) M. J. Larsen & Lombard see *Poria sequoiae*

Prolixandromyces triandrus Santam.
Mycotaxon 32:433. 1988. **ISOTYPE** UC 1475063. On legs of *Velia caprai* Tamanini, Gerona, Catalunya (Catalonia), Spain, S. Santamaria, slide SS747C, 9.viii.1987. Microscope slide.

Protocoronospora phoradendri L. Darling
Madroño 5:242. 1940. **HOLOTYPE** UC 615587, **ISOTYPE** UC 640994. Growing on *Phoradendron macrophyllum* (Engelm.) Cockerell infecting *Salix laevigata* Bebb, near Lakeport, Lake Co., California, Lee Bonar, 30.iii.1934. California Fungi 688; ≡ *Kabatiella phoradendri* (L. Darling) J. M. Harvey, Madroño 11:164. 1951. DeHoog & Hermanides-Nijhof (Stud. Mycol. 15:211. 1977) indicated *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc. in Penz. as the taxon to which NY sample could be referred; however, Darling drew conidiophores bearing 2 spores. Note that von Arx, 1970, Bibliotheca Mycologica 24:76 mentioned that this taxon is close to *Kabatiella harpospora* (Bres. & Sacc.) Arx, which is = *Aureobasidium harposporum* (Bres. & Sacc.) Herm.-Nijhof.

Protopeltis lithocarpi V. P. M. Miller & Bonar
Univ. Calif. Publ. Bot. 19:412. 1941. **HOLOTYPE** UC 617323. On leaves of *Lithocarpus densiflora* (Hook. & Arn.) Rehder, near Inverness, Marin Co., California, H. E. Parks 3573, iii.1931. ≡ *Bonaria lithocarpi* (V. P. M. Miller & Bonar) Bat., Inst. Micol. Univ. Recife Publ. no. 56:439. 1959. (In Farr et al., 1989, listed as *Protopeltis* species not reassigned; in Hawksworth et al., 1983, *Protopeltis* is listed as a synonym of *Myriangiella* [*Myriangiella* is in Schizothyriaceae,

according to von Arx and Müller, Stud. Mycol. 9:28. 1975] and *Bonaria* is listed as a valid genus in Micropeltidaceae.)

Pseudodidymaria wyethiae (Ellis & Everh.) U. Braun see *Marssonia wyethiae*

Pseudovalsa subrufa Ellis & Everh.
Erythea 1:146. 1893. **ISOTYPE** UC 670932. On *Toxicodendron diversiloba* (Torr. & A. Gray) Greene, Berkeley, Alameda Co., California, W. C. Blasdale, ii.1893. ≡ *Thyridaria subrufa* (Ellis & Everh.) Wehmeyer, Lloydia 4:254. 1941. In Wehmeyer, 1941, host listed as *Rhus* sp. Printed label heading. Incorporated into UC with bulk of Blasdale's Herb.

Psora pacifica Timdal *LICHEN*
Bryologist 89:268-269. 1986. **ISOTYPE** UC 1570853. Upper end of Islay Canyon, Santa Cruz Island, Santa Barbara Co., California, W. A. Weber & Charis Bratt, 8.i.1986. Lichenes Exsiccati Distributed by the University of Colorado Museum, Boulder 664.

Psora texana W. A. Weber *LICHEN*
Mycotaxon 6:178. 1977. **ISOTYPE** UC 1456381. Forming rosettes on vertical limestone cliffs, Guadalupe River Canyon, 22.4 km sw of Ingram, Kerr Co., Texas, W. A. Weber, 29.iv.1974. ≡ *Xanthopsorella texana* (W. A. Weber) Kalb & Hafellner, in Hafellner, Beih. Nova Hedwigia 79:348. 1984; ≡ *Xanthopsora texana* (W. A. Weber) Gotth. Schneid. & W. A. Weber in Gotth. Schneid., Biblioth. Lichenol. 13:158. 1979. Lichenes Exsiccati distributed by the Univ. of Colorado at Boulder 448. Mycotaxon 6:179 listed Llano Co. in error.

Puccinia actinostemonis H. S. Jacks. & Holw. in H. S. Jacks.
Mycologia 23:466. 1931. **ISOTYPE** UC 479900. On *Actinostemon* sp., Lapa, State of São Paulo, Brazil, E. W. D. Holway & M. M. Holway, Plants of South America 1600, 27.ii.1922. Reliquiae Holwayanae 333.

Puccinia aenigmatica H. S. Jacks. & Holw. in H. S. Jacks.
Mycologia 24:72. 1932. **ISOTYPE** UC 479816. On *Salvia kuntzeana* Briq., Cochabamba, Cochabamba Dept., Bolivia, E. W. D. Holway & M. M. Holway, Plants of South America 358, 1.iii.1920. Reliquiae Holwayanae 417.

Puccinia aequitatis Cummins
Bull. Torrey Bot. Club 76:35. 1949. **ISOTYPE** UC 927855. On *Benzoin* sp., Loh Hoh Tsuen, Ling Yuin Hsien, Kwangsi Prov., China, S. Y. Cheo 1995, 30.iv.1933.

Puccinia albula H. S. Jacks. & Holw. in H. S. Jacks.
Mycologia 24:136. 1932. **ISOTYPE** UC 479631. On *Baccharis* sp., Nictheroy (Niterói), State of Rio de Janeiro, Brazil, E. W. D. Holway & M. M. Holway, Plants of South America 1149, 23.ix.1921. Reliquiae Holwayanae 602.

Puccinia allaudabilis H. S. Jacks. & Holw. in H. S. Jacks.
Mycologia 24:109. 1932. **ISOTYPE** UC 479715. On *Vernonia argyrotrichia* Sch. Bip., Theresopolis, State of Rio de Janeiro, Brazil, E. W. D. Holway & M. M. Holway, Plants of South America 1199, 8.x.1921. Reliquiae Holwayanae 518.

Puccinia anhweiana Cummins
Mycologia 43:88. 1951. **ISOTYPE** UC 927854. On *Orchis*, Chiu Hua Shan, Ch'ing Yang Hsien, Anhwei Prov., China, S. Y. Cheo 1267, 15.x.1932. Type collection indicated on label. Part I of publication (Mycologia 42: 779. 1950) indicated that specimens were deposited in PUR and FH.

Puccinia aristidae Tracy var. **chaetariae** Cummins & A. Husain
Bull. Torrey Bot. Club 93:63. 1966. **ISOTYPE** UC 1318868. On *Aristida adscensionis* L., entrance to Nat. Forest on road to Washington from

State Highway 82, Santa Cruz Co., Arizona, G. B. Cummins 61-230, 19.ix.1961.

Puccinia blasdalei Dietel & Holw. in Dietel
Erythea 1:248. 1893. **ISOTYPE** UC 976496. On *Allium serratum* S. Wats., near Antioch, Contra Costa Co., California, W. C. Blasdale, 11.v.1893. In protologue date given as May 1893.

Puccinia congdonii Savile
Canad. J. Bot. 50: 2586. 1972. **ISOTYPE** UC 506292. On *Scirpus congdonii* Britton near Jonesville, Butte Co., California, E. B. Copeland, vi.1931. California Fungi 507 (as *P. angustata* Peck).

Puccinia crepidis-acuminatae Syd. & P. Sydow
Oesterr. Bot. Z. 57:27. 1901. **ISOTYPE** UC 1274175. On *Crepis acuminata* Nutt., Kings River Canyon, Fresno Co., California, E. W. D. Holway, 13.vii.1892. N. Amer. Uredinales, E. W. D. Holway Herb., labelled as *P. hieracii* (Röhl.) H. Mart.

Puccinia cruciferarum Rudolphi subsp. ***wyomingensis*** Savile
Mycologia 56: 243. 1964. **ISOTYPE** UC 1138707. On *Cardamine cordifolia* A. Gray, Univ. of Wyoming Science Camp, Medicine Bow Mts., elev. 9800 ft, Albany Co., Wyoming, John Baxter, 24.viii.1953. Mycoflora Saximontanensis Exsiccata 652 (listed as type collection). Date not in protologue.

Puccinia echeveriae Linder
Mycologia 30:667. 1938. **ISOTYPE** UC 605498. On *Echeveria caespitosa* (Haw.) DC., E side of Big Dome, Point Lobos Reserve, Monterey Co., California, L. C. Wheeler 4270, 23.vii.1936.

Puccinia erlangeae Grove
Kew Bull. 1916:270. 1916. **ISOTYPE** UC 1139929. On *Erlangea tomentosa* S. Moore, Limoru, Kisumu, Nyanza Prov., Kenya, R. A. Dummer 1745, ii.1915. Protologue and label lists as Limoru, Kisumu, Nairobi, Africa.

Puccinia graminella Dietel & Holw. in Dietel
Erythea 3:80. 1895. **ISOTYPE** UC 961051. On *Stipa lepida* Hitchc. (as *S. eminens* Cav.), Berkeley, Alameda Co., California, W. C. Blasdale & E. W. D. Holway, 18.v.1894. Arthur & Holway: Uredineae Exsiccatae et Icones 29a. See also Mycologia 50:32. 1958.

Puccinia gulosa H. S. Jackson in Barthol.
Bull. Torrey Bot. Club 47:470. 1920. **ISOTYPE** UC 403186. On *Polemonium pulcherrimum* Hook., Colby Mt., S of Muir Gorge, E end of Grand Canyon of the Tuolumne, Yosemite Nat. Park, elev. 8500 ft, Tuolumne Co., California, M. S. Clemens 24, 6.viii.1919.

Puccinia laurifoliae R. W. Davidson
Mycologia 24:224. 1932. **ISOTYPE** UC 660386. On *Heteropteris laurifolia* (L.) A. Juss. Sanarata [Sanarate], El Progreso Dept., Guatemala, W. A. Kellerman, 28.xii.1907. Ex Herb. Arthur 47238.

Puccinia osoyoosensis Savile
Canad. J. Bot. 50:2587. 1972. **ISOTYPE** UC 1598492. On *Scirpus americanus* Pers., Osoyoos Lake, southern Okanagan Valley, Yale Co., British Columbia, Canada, J. A. Calder 11507 & D. B. O. Savile, 6.viii.1953. Ex DAOM 139216.

Puccinia pallor Arthur & Holw. in Arthur
Mycologia 10:129. 1918. **ISOTYPE** UC 1274630. On *Bomarea acutifolia* Herb., Volcan de Agua, Antigua, Sacatepequez Dept., Guatemala, E. W. D. Holway Plants of Central America 562, 7.iii.1916.

Puccinia palmeri Dietel & Holw. in Dietel
Erythea 7:98. 1899. **ISOTYPE** UC 976588. On *Penstemon confertus* Dougl.,

Lake Tahoe (El Dorado Co.?), California, W. C. Blasdale, vii.1897.

Puccinia paroselae Cummins

Bull. Torrey Bot. Club 68:44. 1941. **ISOTYPE** UC 1064087. On *Dalea mollis* Benth., Santa Rosa Canyon near Indio, Riverside Co., California, H. E. Parks 6430 & M. Jordan, ii.1940. Host syn. *Parosela mollis* Heller.

Puccinia pattersoniana Arthur

Bull. Torrey Bot. Club 33:29. 1906. **ISOTYPE** UC 411544. On *Agropyron spicatum* (Pursh) Scribn. & J. G. Sm., Sandcoulee, Cascade Co., Montana, F. W. Anderson, vii.1888. USDA Bureau of Plant Industry--Pathological Collections Mycological Exchange of 1921 no. 537.

Puccinia pimpinellae (F. Strauss) Röhl. ssp. **carlottae** Savile

Canad. J. Bot. 43:581. 1965. **ISOTYPE** UC 1316786. On *Osmorrhiza chilensis* (Molina) Hook. & Arn., Moresby Logging Camp, Moresby Island, Queen Charlotte Islands, British Columbia, Canada, J. A. Calder 21965, D. B. O. Savile & R. L. Taylor, 30.vi.1957. Ex DAOM no. 106826. Author of fungus species checked in F. Strauss, Ann. Wetterauischen Ges. Gesammte Naturk. 2:102. 1811 (included drawing of teliospores) and Röhling, Deutschlands Flora ed. 2, III, 3:131. 1813 (authors as given by Cummins & Stevenson, Pl. Dis. Reporter, Suppl. 240:161. 1956).

Puccinia praemorsa Dietel & Holw. in Holw.

Bot. Gaz. 31:332. 1901. **ISOTYPE** UC 1274094. On *Brickellia veronicaefolia* (Humb., Bonpl. & Kunth) A. Gray, Oaxaca, Mexico, E. W. D. Holway Fungi of Mexico 3686, 20.x.1899.

Puccinia rufescens Dietel & Holw. var. **rufescens**

Bot. Gaz. 18:253. 1893. **ISOTYPES** UC 1033772, UC 1033773. On *Pedicularis semibarbatus* A. Gray, King's River Canyon, Fresno Co., California, E. W. D. Holway, vii.1892. Sydow Uredineen 781 (UC 1033773) dated July 15, 1892.

Puccinia saxifragae Schltdl. var. **longior** Savile

Canad. J. Bot. 51:2360. 1973. **ISOTYPE** UC 1457433. On *Saxifraga cernua* L., Slope of Mt. Helen, west of Fairy Lake, British Columbia, Canada, I. Kukkonen 487 & J. A. Calder, 19.vii.1960. Ex DAOM 144919. Collector's number as on label.

Puccinia sphaeralceae Gäumann see *Puccinia sphaeralceoides*

Puccinia sphaeralceoides Cummins

Bull. Torrey Bot. Club 79:224. 1952. **ISOTYPE** UC 748784. On *Sphaeralcea ambigua* A. Gray, Cottonwood Springs, Joshua Tree Nat. Monument, Riverside Co., California, J. Westergaard & E. Gäumann, 3.iii.1947. Label date is 5.3.1947; presumably 5.iii.1947; nom. nov. for *Puccinia sphaeralceae* Gäumann, Ber. Schweiz. Bot. Ges. 57:249. 1947; not *P. sphaeralceae* Ellis & Everhart, Amer. Nat. 31:428. 1897.

Puccinia thelypodii Cummins

Mycologia 31:170. 1939. **ISOTYPES** UC 629606, UC 629609. On *Guillenia lasiophylla* (Hook. & Arn.) Greene, Soboba Hot Springs, near San Jacinto, Riverside Co., California, H. E. Parks 6154, 16.ii.1938. UC 629606 on stems, 629609 on leaves. Host in protologue as *Thelypodium lasiophyllum* (Hook. & Arn.) Greene. California Fungi 705.

Puccinia treleasiana Pazschke

Hedwigia 31:317. 1892. **ISOTYPE** UC 959428. On *Caltha leptosepala* DC., Argentine Pass, Clear Creek Co., Colorado, W. Trelease, vii.1886. Issued as Rabenhorst-Winter-Pazschke Fungi Europaei 3821.

Puccinia wulfeniae Dietel & Holw. in Dietel

Erythea 3:79. 1895. **ISOTYPE** UC 1033859. On *Synthyris rotundifolia* A.

Gray, Ukiah, Mendocino Co., California, W. C. Blasdale, 22.v.1894. Host was given in protologue as *Wulfenia cordata*.

Puccinia yosemitana Blasdale
Univ. Calif. Publ. Bot. 7:150. 1919. **HOLOTYPE** UC 211141. On *Leptodactylon pungens* (Torr.) Rydb. (as *Gilia*), Yosemite Valley, Yosemite Nat. Park, Mariposa Co., California, W. C. Blasdale, 11.vii.1919.

Radiomyces spectabilis Embree
Amer. J. Bot. 46:25. 1959. **HOLOTYPE** UC 1139530. Isolated from lizard dung, 18 mi N of Bishop, Mono Co., California, J. Kuijt & S. Cook, undated. Isolated ix.1957, cultured iii.1958 by Embree.

Ramalina euxini Vězda *LICHEN*
Folia Geobot. Phytotax. 14:205. 1979. **ISOTYPE** UC 1473763. On andesite rock near Sozopol, shore of Black Sea, Burgas District, Bulgaria, A. Vězda, 20.ix.1979. A. Vězda: Lichenes Selecti Exsiccati 1668.

Ramalina thraustoides Vain. *LICHEN*
Univ. Calif. Publ. Bot. 12:4. 1924. **ISOTYPE** UC 262676. On bark in Purau Swamp beyond Maraa Caves, Paea Distr., Tahiti, Society Islands, W. A. Setchell (Tahiti no. 5400 in part) with H. E. Parks, 29.v.1922. Mixed with *R. roesleri* (Hochst. ex Schaerer) Hue. Listed as type collection by Alava (1988).

Ramalina wigginsii Bowler & Rundel *LICHEN*
Bryologist 76:213. 1973. **HOLOTYPE** UC 756985. Desierto Viscaino region, Las Tinajas & vicinity in hills E of Los Pichachos de Santa Clara, Baja California Sur, Mexico, H. S. Gentry 7581, 21-23.iii.1947. Photographed specimen labelled holotype is Gentry 7581 [see p. 212]. Given in protologue as Gentry 7580, UC 756890; error in place name as Trinajas. Kashiwadani and Nash, Acta Bot. Fenn. 150:91. 1994 erroneously gave the location of the holotype as US.

Ramularia phaceliae Bonar
Mycologia 38:344. 1946. **HOLOTYPE** UC 697788. On living leaves of *Phacelia procera* A. Gray, near Gold Lake, Plumas Co., California, L. Bonar, 31.vii.1942. California Fungi 824; = *Cylindrosporium phaceliae* Ellis & Everh. (see Braun, Nova Hedwigia 56:451. 1993).

Rasutoria pseudotsugae (V. P. M. Miller & Bonar) M. E. Barr see *Dimeriella pseudotsugae*

Rhizoctonia fumigata (Nakata ex Hara) P. S. Gunnell & R. K. Webster see *Sclerotium fumigatum*

Rinodina calculiformis W. A. Weber *LICHEN*
Bryologist 67:473. 1964. **ISOTYPE** UC 1317775. On volcanic scoria, Isla Guadalupe, Melpomene Cove, Baja California, Mexico, W. A. Weber & C. J. McCoy, Jr. s.n., 21.iv.1963. Lichenes Exsiccati Distributed by the University of Colorado Museum, Boulder 94.

Roccellina conformis Tehler *LICHEN*
Opera Bot. 70:50. 1983. **ISOTYPE** UC 1570895. On *Heteromeles arbutifolia* (Aiton) M. Roem., just W of Hamilton Beach near Avalon, Santa Catalina Island, Los Angeles Co., California, A. Tehler 1402a, 5.vii.1976.

Ruhlandiella hesperia Setch.
Univ. Calif. Publ. Bot. 4:116. 1910. **HOLOTYPE** UC 126152. On clay under *Eucalyptus* leaves, Univ. of California campus, Berkeley, Alameda Co., California, N. L. Gardner 67, 8.ii.1903. = *R. berolinensis* Henn., Hedwigia 42:24. 1903. Mycotaxon 12:295. 1980 lists incorrect accession number for holotype.

Schismatomma cupressum Herre *LICHEN*
Bryologist 55:295. 1952. **LECTOTYPE** UC 141278. On trunks of *Cupressus macrocarpa* Gordon, Cypress Point, Seventeen Mile Drive, Monterey Co., California, A. W. C. T. Herre 121, 7.viii.1909. Lectotypified by A. Tehler, Opera Bot. 70:48. 1983; = *Roccellina franciscana* (Zahlbr. ex Herre) Follmann in Huneck & Follmann (see Tehler, 1983).

Schismatomma rediunta (Hasse) Tehler see *Lecanora rediunta*

Schizodiscus afroalpinus Brusse *LICHEN*
Bothalia 18:95. 1988. **ISOTYPE** UC 1570878. On low basalt exposures, 31 km S of Phuthaditjhaba (Witsieshoek), Mont-aux-Sources, 3080 m elev., western border of Natal Prov., South Africa, F. Brusse 4523, 21.i.1986.

Scleropleella personata (Niessl) Hohn. see *Leptosphaeria personata*

Sclerotium fumigatum Nakata in Hara
Pathologia Agriculturalis Plantarum, Yokendo, Tokyo, p. 168. 1930. **NEOTYPE** UC 1475045. Dried culture CBS 577.81 (originally from Japan), collector unknown, undated. ≡ *Rhizoctonia fumigata* (Nakata ex Hara) P. S. Gunnell & R. K. Webster, Mycologia 79:735. 1987; neotype designated by Gunnell & Webster.

Scolecobonaria lithocarpi (V. P. M. Miller & Bonar) Bat. see *Limacinia lithocarpi*

Secotium tenuipes Setch.
J. Mycol. 13:239. 1907. **HOLOTYPE** UC 221827, **ISOTYPE** UC 126135. Under *Eucalyptus* leaves, University of California campus, Berkeley, Alameda Co., California, N. L. Gardner 229, 12.xii.1904. ≡ *Setchelliogaster tenuipes* (Setch.) Pouzar, Česká Mykol. 12:34. 1958. See study by Singer and Smith, Madroño 15:73. 1959.

Seimatosporium arbuti (Bonar) Shoemaker see *Disaeta arbuti*

Semimorula liquescens E. F. Haskins, McGuinn., & C. S. Berry
Mycologia 75:156. 1983. **ISOTYPE** UC 1571355. Growing over dried infructescences of *Solidago* sp. and *Lythrum salicaria* L., Kirkland, King Co., Washington, E. F. Haskins 848, undated. Microscope slide.

Septogloeum cercocarpi Bonar
Mycologia 38:344. 1946. **HOLOTYPE** UC 697790, **ISOTYPE** UC 733976, **PARATYPES** UC 733975, UC 733994, UC 733996. On living leaves of *Cercocarpus betuloides* Torr. & A. Gray, Hastings Natural History Reservation (E. Carmel Valley Rd.), Monterey Co., California, J. M. Linsdale, 1.vi.1941. ≡ *Phloeospora cercocarpi* (Bonar) B. Sutton & Pollack, Mycopath. Mycol. Appl. 52:349. 1974 (on p. 350, entry suggests erroneously that IMI 160456 is holotype rather than UC 697790). UC 733975, Linsdale, 3:vii:1941, UC 733996 (Gifford), erroneously printed as 17:iv:1934 rather than 7:iv.

Septoria angularis H. N. Hansen & H. E. Thomas see *Septoria fremontiae*

Septoria fremontiae Bonar
Mycologia 38:345. 1946. **HOLOTYPE** UC 688926. On leaves of *Fremontodendron mexicanum* Davidson, Nursery, Morgan Hill, Santa Clara Co., California, H. E. Thomas, v.1935, nom. nov. for *Septoria angularis* H. N. Hansen & H. E. Thomas, Madroño 8:42. 1945, non *S. angularis* Dearn. & Barthol., Mycologia 8:103. 1913.

Septoria sileris Petrak
Sydowia 1:128. 1947. **ISOTYPE** UC 760378. On living and dying leaves of *Siler trilobum* (L.) Crantz, in woods at base of Pfaffstättnerkogel near Baden, Niederösterreich, Austria, F. Petrak, 20.vi.1940. Cryptogamas exsiccatas, editae a Museo Historiae Naturalis

Vindobonensi 3620, mislabelled *S. vindobonensis*. Host syn. of *Laser trilobum* (L.) Borkh.

Septoria vindobonensis Petrak
Sydowia 1:130. 1947. **ISOTYPES** UC 800638, 800643. On *Seseli libanotis* (L.) Koch (as *Libanotis montana* Crantz), Pfaffenberg near Deutsch-Altenburg, Niederösterreich, Austria, F. Petrak, ix.1940.

Setchelliogaster tenuipes (Setch.) Pouzar see *Secotium tenuipes*

Spathularia spathulata (S. Imai) Mains see *Cudonia spathulata*

Sphaeria atropurpurea Fr.: Fr.
Syst. Mycol. 2:340. 1823, non Tode. **ISOTYPE** UC 414172. Fries, Scleromyceti Sueciae Exs. 75 (cited by Fries). ≡ *Nemania atropurpurea* (Fr.: Fr.) Pouzar, Česká Mykol. 39:19. 1985, which was placed in synonymy with *Hypoxylon atropurpureum* (Fr.: Fr.) Fr. (Summa Veg. Scand. p. 384. 1849) by Petrini & Rogers, Mycotaxon 26: 414. 1986, who listed no. 75 as type, seen at K, UPS.

Sphaerotheca shepherdiae U. Braun
Z. Mikrobiol. 140:237. 1985. **ISOTYPE** UC 1458796. On *Shepherdia argentea* Nutt., Billings, Yellowstone Co., Montana, E. T. Bartholomew & E. Bartholomew, 21.viii.1913. Labelled *S. humuli* (DC.) Burrill; Fungi Columbiani--E. Bartholomew 4389, cited by Braun as type.

Sphaerotheca violae U. Braun
Z. Mikrobiol. 140:238. 1985. **ISOTYPE** UC 652982. On leaves of *Viola canadensis* L., Laramie Hills, Laramie, Albany Co., Wyoming, W. G. Solheim 43, 4.viii.1930. Mycoflora Saximontanensis Exsiccata 18, labelled as *S. humuli* (DC.) Burrill. See also Braun, Beih. Nova Hedwigia 89. 1987.

Spilocaea photinicola (R. L. McClain) M. B. Ellis see *Fusicladium photinicola*

Spiniger meineckella (A. J. Olson) Stalpers see *Cunninghamiella meineckella*

Sporidesmium bonarii M. B. Ellis
Mycol. Pap. 70:82. 1958. **HOLOTYPE** UC 804618. On *Torreya californica* Torr., near summit of Mt. Tamalpais, Marin Co., California, L. Bonar, 1.x.1949. Nom. nov. for *Clasterosporium obclavatum* Bonar [non *C. obclavatum* (Cooke) Sacc., Syll. Fungorum 4: 386. 1886], Mycologia 43:64. 1951; ≡ *Janetia bonarii* (M. B. Ellis) S. Hughes, New Zealand J. Bot. 21:181. 1983. California Fungi 761.

Sporidesmium garryae Bonar
Mycologia 57:393. 1965. **HOLOTYPE** UC 1272186. On living and dead leaves of *Garrya fremontii* Torr., Longbarn, Tuolumne Co., California, C. R. Quick 58-D13, 30.vii.1958. ≡ *Janetia garryae* (Bonar) S. Hughes, New Zealand J. Bot. 21:181. 1983.

Squamuloderma nullifilum Kowalski
Mycologia 64:1284. 1972. **LECTOTYPE** UC 1445692. Cultured from dung, Honeyrun Road, 1 mi above Covered Bridge, Butte Co., California, D. T. Kowalski 11182, vi.1971. ≡ *Didymium nullifilum* (Kowalski) M. L. Farr, Mycologia 74:341. 1982. CHSC does not have the portion of the type supposedly retained by Kowalski (personal correspondence from R. Critchfield, 5.ii.1993); therefore, UC 1445692, labelled as type by Kowalski, is being designated as lectotype.

Stagonospora gigantea F. D. Heald & F. A. Wolf
Mycologia 3:9. 1911. **ISOTYPE** UC 971418. On *Agave americana* L., Austin, Travis Co., Texas, F. D. Heald & F. A. Wolf 1283, 22.v.1909. Cited by Ramaley in Mycotaxon 45:454. 1992.

Stephanoma phaeospora E. E. Butler & McCain
Mycologia 60:956. 1968. **HOLOTYPE** UC 1320682. Isolated from root tissue of *Cattleya* sp., San Mateo Co., California, collector not indicated, 1962.

Sticta lobariaeformis Vain. *LICHEN*
Univ. Calif. Publ. Bot. 12:6. 1924. **ISOTYPE** UC 261072. On trees, Maara Valley, Papeari Distr., Tahiti, Society Islands, W. A. Setchell (Tahiti no. 5421) with H. E. Parks, 29.vi.1922. Labelled as paratype, but 5421 is the only collection cited. Listed as type collection by Alava (1988).

Stictis myricae Cash
Mycologia 50:655. 1958. **ISOTYPE** UC 1269693. On *Myrica californica* Cham. & Schltdl., Spruce Cove, Trinidad, Humboldt Co., California, H. E. Parks 7005, 24.i.1947. California Fungi 1209; = *Propolis phacidioides* (Fr.) Corda, Mycotaxon 5:329. 1977.

Strigopodia spongiosum (M. E. Barr) M. E. Barr see *Capnodium spongiosum*

Strigula parksii Räsänen apud Sbarbaro *LICHEN*
Arch. Bot. (Forli) 15:102. 1939. **ISOTYPE** UC 568766. Eua Island, Tonga, H. E. Parks 16626(L10), vi-vii.1926. Protologue erroneously lists collector as S. T. Parks, Eua Is., 1929; = *Strigula subelegans* Vain.; see Santesson, Symb. Bot. Upsal. 12(1):158. 1952, who studied Sbarbaro's specimen, referred to as isotype.

Strumella simmondsiae Bonar
Mycologia 34:190. 1942. **HOLOTYPE** UC 653866. On living leaves, calyxes & peduncles of *Simmondsia chinensis* (Link) C. K. Schneid. (as *S. californica* Nutt.), south of Hemet, Riverside Co., California, H. S. Fawcett, 7.v.1939.

Sugiyamaemyces oroussetii I. I. Tav. & Balazuc
Mycotaxon 34:566. 1989. **HOLOTYPE** UC 1475062. On *Clidicus formicarius* Pascoe (Coleoptera, Scydmaenidae, Clidicinae), Borneo, Malaysia, A. R. Wallace?, undated. Type of genus. Microscope slide.

Syncephalis californica W. E. Hunter & E. E. Butler
Mycologia 67:863. 1975. **HOLOTYPE** UC 1445871. Cultured as a parasite on *Rhizopus oryzae* Went; isolated from soils in orchards of *Prunus armeniaca* L. (apricot) and *P. domestica* L. (prune), Sacramento Valley (Co. not indicated), California, W. E. Hunter & E. E. Butler, vii.1971.

Syncephalis plumigaleata Embree
Amer. J. Bot. 52:737. 1965. **HOLOTYPE** UC 1208989. From rodent dung, Zimbabwe (as southern Rhodesia, Africa), R. W. Embree cult. 63-1, iii.1963.

Synchytrium akshaiberi Lingappa
Mycologia 45:292. 1953. **ISOTYPE** UC 1516473. On leaves of *Solanum melongena* L., Varanasi (Banaras), State of Uttar Pradesh, India, B. T. Lingappa, 21.ix.1950. HCIO 20479; Herb. Crypt. Ind. Orient. Exsiccati Indian Synchytria (Fasc. I), no. 2.

Synchytrium cookii Lingappa
Mycologia 45:291. 1953. **ISOTYPE** UC 1516470. On leaves and stems of *Alysicarpus monilifer* DC., Varanasi (Banaras), State of Uttar Pradesh, India, B. T. Lingappa, 12.ix.1950. HCIO 20480; Herb. Crypt. Ind. Orient. Exsiccati Indian Synchytria (Fasc I), no. 8.

Synchytrium eremocaryae Karling
Sydowia 10:20. 1956. **HOLOTYPE** UC 266329. On *Eremocarya*? (syn. of *Cryptantha*), Griffith Park, Los Angeles, Los Angeles Co., California,

M. S. Clemens 10800, 4.iii.1922. Spelling errors in protologue: *S. eremocarpae* on *Eremocarpus*.

Synchytrium lagenariae Mhatre & Mund.
Lloydia 8:135. 1945. **ISOTYPE** UC 1516459. On leaves of *Lagenaria vulgaris* Ser., Pusa, State of Bihar, India, L. S. S. Mony, 31.viii.1916. HCIO 2019; Herb. Crypt. Ind. Orient. Exsiccati Indian Synchytria (Fasc. I) no. 18. Authors' names reversed on label; host on label (correction of determination?) is *L. leucantha* (Dutch) Rusby and collector's name, Money.

Synchytrium meliloti Lingappa
Mycologia 45:293. 1953. **ISOTYPE** UC 1516457. On leaves and stems of *Melilotus indica* All. (syn. *M. parviflora* Desf.), Varanasi (Banares, Banaras), State of Uttar Pradesh, India, B. T. Lingappa, 25.ix.1951. HCIO 20478; Herb. Crypt. Ind. Orient. Exsiccati Indian Synchytria (Fasc. I), no. 22.

Synchytrium parksii Karling
Bull. Torrey Bot. Club 83:416. 1956. **HOLOTYPE** UC 502876. On leaves and petioles of *Trifolium microdon* Hook. & Arn., Blue Slide on Van Duzen River, Humboldt Co., California, J. P. Tracy 9314 with H. E. Parks, 26.iii.1931.

Synchytrium solivae Karling
Sydowia 10:19. 1956. **HOLOTYPE** UC 128871. On *Soliva sessilis* Ruiz Lopez & Pavon, Smith River, E of Gasquet, Del Norte Co., California, J. P. Tracy 10006 with H. E. Parks, 15.v.1932. In protologue misspelled as *Synchytrium salviae* and *Salvia*.

Synchytrium ulmariae K. Falck & Lagerh.
Ark. Bot. 12(5):4. 1912. **ISOTYPE** UC 211047. On *Filipendula ulmaria* (L.) Maxim. (syn. *Ulmaria pentapetala* Gilib.), Fjallnas, Jämtland, Sweden, C. Lagerheim, 1897.

Synchytrium variabilum Karling
Bull. Torrey Bot. Club 83:415. 1956. **LECTOTYPE** UC 527090. On leaves and petioles of *Ranunculus occidentalis* Nutt., Horse Mountain, elev. 4500 ft, Humboldt Co., California, J. P. Tracy 12668, 11.vii.1933. Karling annotated UC 527090 as type, but did not state which collection was the type in the protologue; consequently UC 527090 is here designated as lectotype; other cited collection was from Eel River.

Thecaphora ruppiae Setch.
Mycologia 16:243. 1924. **HOLOTYPE** UC 229840. On leaves and stems of *Ruppia maritima* L. var. *rostrata* C. Agardh (laboratory cult. from collection from Alto, Marin Co.), California, W. A. Setchell, v.1924. Syn. of *Tetramyxa parasitica* K. I. Goebel; see C. H. Ostenfeld & H. E. Petersen: Z. Bot. 23:17. 1930. Plasmodiophorales, originally misidentified.

Thyridaria subrufa (Ellis & Everh.) Wehmeyer see *Pseudovalsa subrufa*

Tieghemiomyces californicus R. K. Benj.
Aliso 4:390. 1959. **ISOTYPE** UC 1270727. Cultured from mouse dung at Evey Canyon, NE of Claremont, Los Angeles Co., California, R. K. Benjamin RSA cult. 467, 28.iv.1956. Cultured on *Cokeromyces recurvatus* Poitras on YpSs, 12-25.x.1962.

Tieghemiomyces parasiticus R. K. Benj.
Aliso 5: 11. 1961. **ISOTYPE** UC 1270728. Cultured from mouse dung, Champaign Co., Illinois, E. Dickens D422, 26.iii.1959. RSA culture 861; isolated by R. K. Benjamin. Cultured on *Cokeromyces recurvatus* Poitras on YpSs, 17.ix--15.x.1962.

Tilletia opaca Syd. & P. Syd.
Philipp. J. Sci. 8:265. 1913. **ISOTYPE** UC 211648. On *Spinifex squarrosus* L., Parañaki (Parañaque), Rizal Prov., Luzon, Philippines, W. R. Shaw, vii.1911. ≡ *Neovossia opaca* (Syd. & P. Syd.) Vánky, Mycotaxon 48:39. 1993. Distinct from *Tilletia maclagani* (Berk.) G. P. Clinton (compare Duran & Fischer, 1961, p. 78).

Tilletia pulcherrima Ellis & Galloway
Proc. Boston Soc. Nat. Hist. 31:441. 1904. **ISOTYPE** UC 68157. In ovaries of *Panicum virgatum* L., Champaign, Champaign Co., Illinois, G. P. Clinton, 8.ix.1897. ≡ *Neovossia pulcherrima* (Ellis & Galloway ex G. P. Clinton) Vánky (Mycotaxon 38: 272. 1990.). Economic Fungi, Seymour and Earle, suppl. C, no. C 52.

Torula thermophila Cooney & R. Emers.
Cooney & Emerson, Thermophilic Fungi, 1964, p. 92. **HOLOTYPE** UC 1206525. On straw litter from a chicken nest, Reno, Washoe Co., Nevada, D. G. Cooney cult. no. 3, 1950. Cooney & Emerson's cult. no. 3, subcultured December, 1961.

Tracya lemnae Setch. ex Syd. & P. Syd.
Hedwigia, Beibl. 40:(3). 1901. **LECTOTYPE** UC 48458, **ISOLECTOTYPE** UC 48454. On *Spirodela polyrrhiza* (L.) Schleid., Glacialis Pond, Cambridge, Middlesex Co., Massachusetts, W. A. Setchell, 30.vi.1889, nom. nov. for *Cornuella lemnae* Setch. v.1891, non *Cornuella* Pierre, i.1891. Proc. Amer. Acad. Arts 26:19. 1891. Setchell listed three different collections, without date. Type locality indicated by Zundel, 1953. Vánky, 1987, p. 118, indicated that type was selected by Zundel; however, no herbarium was listed. We designate UC 48458 as lectotype; it was marked type in Setchell's handwriting; see also Stafleu & Cowan, 1985.

Trichia brunnea J. J. Cox
Mycologia 73:741. 1981. **HOLOTYPE** UC 1568727. On cow dung, State Highway 299, Canby, Modoc Co., California, J. J. Cox 570, 17.ix.1978.

Trichia synsporum Kowalski & E. L. McNichols in Kowalski
Mycologia 66:372-373. 1974. **ISOTYPE** UC 1445913. 1 mi below Hurricane Ridge, Olympic Nat. Park, elev. 5000 ft, Clallam Co., Washington, D. T. Kowalski 12547, 22.vi.1972. Our specimen bears the no. 12527, a misprint. Protologue mentions only one known coll. and a portion was deposited in UC. CHSC specimen is hereby designated as lectotype.

Trichomerium atronitidum (V. P. M. Miller & Bonar) Cif. & Bat. see *Vertixore atronitidum*

Tricornispora bambusae Bonar
Mycologia 59:597. 1967. **HOLOTYPE** UC 405186. On *Bambusa spinosa* Roxb., Zaragosa, Nueva Ecija Prov., Luzon, Philippines, J. Clemens (Phil. Bur. Sci. 18809), 6.ii.1929. Although *Tricornispora* Bonar is listed in Hawksworth et al., 1983, as a synonym of *Tridentaria*, the genus was accepted by Aa and Oorschot, Persoonia 12: 416. 1985 (see their illustrations of type material on pp. 421-422).

Tuber argenteum Gilkey
Univ. Calif. Publ. Bot. 6:345 (also see 318). 1916. **HOLOTYPE** UC 126119, **ISOTYPE** UC 1273082. Ingleside, San Francisco Co., California, N. L. Gardner 284, 11.v.1905.

Tuber canaliculatum Gilkey
Oregon State Monogr. Stud. Bot. 1:41. 1939. **HOLOTYPE** UC 620892. New Richmond, Allegan Co., Michigan, Mrs. C. H. Kauffman, 12.ix.1910.

Tuber gardneri Gilkey
Univ. Calif. Publ. Bot. 6:345 (also see 317). 1916. **HOLOTYPE** UC

126116. Under *Arbutus menziesii* Pursh, Leona Heights near Oakland, Alameda Co., California, N. L. Gardner 274, 4.iii.1905. Protologue did not indicate that Leona Heights coll. was no. 274; = *Tuber albidum* Pico (1788) according to Ceruti, Allionia 7:1. 1961.

Tuber irradians Gilkey
Univ. Calif. Publ. Bot. 6:344 (also see 316). 1916. **HOLOTYPE** UC 511627. Diamond Canyon, Oakland, Alameda Co., California, N. L. Gardner 281, 25.iii.1905. = *Tuber foetidum* Vitt. (1831) according to Ceruti, Allionia 7:1. 1961.

Tuber levissimum Gilkey
Univ. Calif. Publ. Bot. 6:344 (also see 313). 1916. **HOLOTYPE** UC 775219, **ISOTYPE** UC 511629. California, C. F. Drew (N. L. Gardner 338), v.1912. Probably collected in San Francisco Bay area.

Uredinopsis aspera Faull
Contr. Arnold Arbor. 11:79. 1938. **ISOTYPE** UC 1033923. On *Pteridium aquilinum* (L.) Kuhn var. *pubescens* (L.) Underw., Pasadena, Los Angeles Co., California, A. J. McClatchie, 25.i.1893. Host as *Pteridium aquilinum* L. var. *lanuginosum* Hook., a syn.; = *Uredo pteridis* Dietel & Holway, nom. inval., Erythea 2:127. 1894 (telia present but not included in protologue); = *Uredinopsis hashiokae* Hirats. f. (as corrected orthographically), according to Ziller, 1974, p. 197, but accepted as separate taxon by Faull, 1938, p. 81.

Uredo spirostachydis Arth.
Bull. Torrey Bot. Club 37:576. 1910. **ISOTYPE** UC 653509. On *Allenrolfea occidentalis* (S. Wats.) Kuntze, north of Yuma, Yuma Co., Arizona, M. E. Jones, 26.iv.1906. Label stamped 7815, with host *Allenrolfea* (*Spirostachys*) *occidentalis*.

Uromyces beloperones G. F. Laundon
Mycol. Pap. 89:78. 1963. **ISOTYPE** UC 471836. On *Beloperone californica* Benth., Carriso Canyon, Imperial Co., California, H. E. Parks 3951 with W. K. Parks, 20.i.1932. California Fungi 379, as *U. ruelliae* Holw. Teliospores not seen in uredinia in UC 471836.

Uromyces galii-californici Linder
Mycologia 30:668. 1938. **ISOTYPE** UC 605496. On *Galium californicum* Hook. & Arn., nw slope of Whaler's Knoll, Point Lobos Reserve, Monterey Co., California, L. C. Wheeler 4260, 15.vii.1936.

Usnea eyerdamii Herre var. ***eyerdamii*** *LICHEN*
Rev. Bryol. Lichénol. (n. s.) 29:274. 1960. **HOLOTYPE** UC 1203271. On *Fitzroya cupressoides* (Molina) I. M. Johnston (as *F. patagonica*), Cordillera de Alerce, Bima Distr., Valdivia Prov., Chile, W. J. Eyerdam 11842a, 12.ii.1958. Data from specimen. Sixth UC Botanical Garden Expedition to Andes, 1957-1958.

Usnea eyerdamii Herre var. ***nigro-rubra*** Herre *LICHEN*
Rev. Bryol. Lichénol. (n. s.) 29:274. 1960. **HOLOTYPE** UC 1203269. On rock? (reported to be on *Fitzroya patagonica*, a syn. of *F. cupressoides* [Molina] I. M. Johnston), Cordillera de Alerce, Bima Distr., Valdivia Prov., Chile, W. J. Eyerdam 11842, 12.ii.1958. Data from specimen. Sixth UC Botanical Garden Expedition to Andes, 1957-1958.

Usnea fautauensis Vainio *LICHEN*
Univ. Calif. Publ. Bot. 12:3. 1924. **ISOTYPE** UC 261078. On bark of trees, Fautaua Valley, Tahiti, W. A. Setchell (Tahiti no. 5445) with H. E. Parks, 31.v.1922. Specimen in UC marked paratype in error; specimen in TUR-V listed as type collection by Alava, 1988.

Ustilago bethelii Zundel
Mycologia 25:350. 1933. **ISOTYPE** UC 680695. On *Muhlenbergia montana* (Nutt.) Hitchc., Idaho Springs, Clear Creek Co., Colorado, E. Bethel, 3.ix.1923.

Ustilago caricis (Pers.: Pers.) Unger var. ***douglasii*** Shear in Ellis & Everh. see *Anthracoidea douglasii*

Ustilago caulicola Zundel
Mycologia 34:123. 1942. **ISOTYPES** UC 700493, UC 1463941. On *Polygonum campanulatum* Hook. f. var. *fulvidum* Hook. f., Chiang Kou Hsein, Fan Ching Shan, Kweichow Prov., China, S. Y. Cheo 622, 1.x.1931. Reliquiae Farlowianae 950; = *Ustilago ocrearum* Berk. (see Tai, 1979, p. 799). Label gives host as *Polygonum* sp. Protologue omits Hsein from locality.

Venturia rhamni (Bonar) M. E. Barr see *Phaeosphaerella rhamni*

Verticicladiella wageneri W. B. Kendr. var. ***ponderosa*** T. C. Harr. & F. W. Cobb
Mycologia 78:566. 1986. **HOLOTYPE** UC 1475041. Isolated from *Pinus ponderosa* Lawson, McCloud Flat, Siskiyou Co., California, T. C. Harrington, vii.1980. ≡ *Leptographium wageneri* (W. B. Kendr.) M. J. Wingf. var. *ponderosum* (T. C. Harr. & F. W. Cobb) T. C. Harr. & F. W. Cobb, Mycotaxon 30:505. 1987. Teleomorph: *Ophiostoma wageneri* (Goheen & F. W. Cobb) T. C. Harr. Mycotaxon 28:42, 1987; ≡ *Ceratocystis wageneri* Goheen and F. W. Cobb, Phytopathology 68:1193. 1978.

Vertixore atronitidum V. P. M. Miller & Bonar
Univ. Calif. Publ. Bot. 19:406. 1941. **HOLOTYPE** UC 498807. On *Ceanothus griseus* (Trel.) McMinn (as *C. thyrsiflorus* Eschsch. v. *griseus* Trel.), Asilomar, Monterey Co., California, V. P. M. Miller, 13.iii.1932. California Fungi 748; ≡ *Trichomerium atronitidum* (V. P. M. Miller & Bonar) Cif. & Bat., Saccardoa no. 2:97. 1963. Reynolds, Mycotaxon 14:202. 1982, placed *Phaeochaetia arbutifoliae* Bat., Cif., & Nascim. in synonymy with *V. atronitidum* and indicated that they appear to belong to *Chaetothyrium*. *Trichomerium* is a syn. of *Phragmocapnias* according to Hawksworth et al., 1983; *Vertixore* is a syn. of *Aithaloderma*, according to von Arx & Müller, Stud. Mycol. no. 9: 114. 1975 (as *Vestixore*).

Xanthopsora texana (W. A. Weber) Gotth. Schneid. & W. A. Weber in Gotth. Schneid. see *Psora texana*

Xanthopsorella texana (W. A. Weber) Kalb & Hafellner see *Psora texana*

Zymoxenogloea eriophori D. McLaughlin & Doublés in Doublés and McLaughlin
Mycologia 84:671. 1992. **ISOTYPE** UC 1598373. Growing in culture of *Kriegeria eriophori* Bres. isolated from leaves of *Scirpus atrovirens* Willd., Fort Snelling State Park, Hennepin-Dakota Co. line, Minneapolis, Minnesota, viii.1987, vi., vii., viii.1989. Dried culture of DJM 463-SS6 on malt-yeast-peptone agar, ca. 60 hours old, D. J. McLaughlin & J. C. Doublés, 12.vii.1991. Anamorph of *Kriegeria eriophori* Bres. (syn. *Xenogloea eriophori* [Bres.] Syd. & P. Syd.).

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LITERATURE CITED

Alava, R. 1988. Edvard August Vainio's Types in Tur-V and other Herbaria. Publications from the Herbarium no. 2. University of Turku, Turku, Finland. 513 p.

Bigelow, H. E. 1982. North American species of *Clitocybe*. Part I. Beih. Nova Hedwigia 72:1-280.

Bridson, G. D. R. (Ed.), and E. R. Smith. 1991. Botanico-Periodicum-Huntianum/Supplementum. Hunt Institute, Pittsburgh. 1068 p.

Brummitt, R. K., and C. E. Powell, ed. 1992. Authors of Plant Names. Royal Botanic Gardens, Kew. 732 p.

Ceruti, A. 1960. Elaphomycetales et Tuberales. vol. 28, Supplement II, in Bresadola, J. Iconographia Mycologica. Comitato Onoranze Bresadoliane Trento. Trento. 48 p. with unnumbered pages. Tab. 1-48.

Chupp, C. 1953. A Monograph of the Fungus Genus Cercospora. Published by author, Ithaca, New York. 667 p.

Cooney, D. G., and R. Emerson. 1964. Thermophilic Fungi, an Account of their Biology, Activities, and Classification. W. H. Freeman & Co., San Francisco, London. 188 p.

Davis, H. B. 1937. Life and Work of Cyrus Guernsey Pringle. Published by University of Vermont, Burlington. 756 p.

Duran, R., and G. W. Fischer. 1961. The Genus Tilletia. Washington State Univ., Pullman. 138 p.

Ellis, M. B. 1976. More Dematiaceaceous Hyphomycetes. Commonwealth Mycological Institute, Kew. 507 p.

Eriksson, J., K. Hjortstam, and L. Ryvarden. 1981. The Corticiaceae of North Europe. Vol. 6. Pp. 1051-1276. Fungiflora, Oslo.

Farr, D. F., G. F. Bills, G. P. Chamuris, & A. Y. Rossman. 1989. Fungi on Plants and Plant Products in the United States. (Contrib. U. S. Nat. Fungus Collections no. 5.) American Phytopathological Society Press, St. Paul. 1252 p.

Greuter, W., Chairman Ed. Comm. 1988. International Code of Botanical Nomenclature. Koeltz Scientific Books, Konigstein. 328 p.

Hawksworth, D. L., B. C. Sutton, and G. C. Ainsworth. 1983. Ainsworth & Bisby's Dictionary of the Fungi. Seventh Ed. Commonwealth Mycological Institute, Kew. 445 p.

Hickman, J. C, ed. 1993. The Jepson Manual, Higher Plants of California. Univ. of California Press, Berkeley, Los Angeles, London. 1400 p.

Holmgren, P. K., N. H. Holmgren, and L. C. Barrett, ed. 1990. Index Herbariorum, part I. The Herbaria of the World. Eighth Ed. New York Botanical Garden, Bronx, New York. 693 p.

Lawrence, G. H. M., A. F. Gunther Buchheim, G. S. Daniels, and H. Dolezal. 1968. Botanico-Periodicum-Huntianum. Hunt Botanical Library. Pittsburgh. 1063 p.

Stafleu, F. A., and R. S. Cowan. 1985. Taxonomic Literature, a Selective Guide to Botanical Publications and Collections with Dates, Commentaries and Types. Second ed. Vol. 5. Bohn, Scheltema and Holkema, Utrecht, Antwerp, W. Junk, Publishers, The Hague, Boston. 1066 p.

Sutton, B. C. 1980. The Coelomycetes, Fungi Imperfecti with Pycnidia, Acervuli and Stromata. Commonwealth Mycological Institute. 696 p.

Tai, F. L. 1979. Sylloge Fungorum Sinicorum. Science Press, Academia Sinica, Beijing. 1527 p.

Tuckerman, E. 1866. Lichens of California, Oregon and the Rocky Mountains; so far as yet known. J. S. & C. Adams, Amherst. 35 p.

Vánky, K. 1987. Illustrated Genera of Smut Fungi. (Cryptogamic Studies Vol. 1.) Gustav Fischer Verlag, Stuttgart, New York. 159 p.

Ziller, W. G. 1974. The Tree Rusts of Western Canada. Canadian Forestry Service Publ. no. 1329. Victoria, British Columbia. 272 p.

Zundel, G. L. 1953. The Ustilaginales of the World. (Contrib. No. 176, Dept. Bot., Pennsylvania State College, School of Agric.) State College, Pennsylvania. 410 p.

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TAXONOMY OF *COOKEINA* IN CHINA*

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Abstract: This paper discusses the genus *Cookeina* in China. The known species in this country are described and some illustrated. *Cookeina sinensis* is treated as a new species and *C. indica* recorded for the first time from China. A key to the Chinese species is provided.

Key words: *Cookeina*, *Cookeina sinensis*, *Cookeina indica*, China

The genus *Cookeina* Kuntze includes very conspicuous and commonly collected members of the suboperculate cup fungi. Most of them are tropical and subtropical species. Taxonomy and distribution of the genus have been studied by mycologists in different countries (Seaver, 1927; Le Gal, 1953; Denison, 1967; Rifai, 1968; Pfister & Kaushal, 1984; Eriksson & Hawksworth, 1993). Species concepts are generally clear in this genus.

In dealing with this group of discomycetes in China, only the genus *Cookeina* has been accepted. Teng (1935) recorded two species, *C. insititia,* and *C. sulcipes* (Berk.) Kuntze [=*C. speciosa* (Fr. : Fr.) Dennis]. Later, he added *C. tricholoma* (Mont.) Kuntze (Teng, 1936, 1939) and *C. colensoi* (Teng, 1963). Tai (1979) accepted the above four species in his *Sylloge Fungorum Sinicorum*. Specimens were mainly collected from the southern provinces of China including Yunnan, Hainan, Guangxi, and Guizhou. A new species, *C. sinensis,* and a new record, *C. indica* Pfister & R. Kaushal, are added in this paper. So far, six of the seven known *Cookeina* species in the world are found in China.

All this work is based upon specimens preserved in the Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences (HMAS) and Herbarium of Cryptogams, Kunming Institute of Botany, Chinese Academy of Sciences (HKAS), and some unidentified collections obtained in recent years. Colors of the dry apothecia follow

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names given in *Color Standards and Color Nomenclature* (Ridgway, 1912). Measurements were made from tissues mounted in cotton blue-glycerin-lactophenol solution.

Key to the known species of *Cookeina* in China

1. Receptacle with distinct, fasciculate hairs 2
1'. Receptacle smooth or at least without long, prominent hairs 5
    2. Ascospores smooth 3
    2'. Ascospores with longitudinal striations 4
3. Hairs broad, pyramidal, distributed along margin of apothecia; ascospores fusoid to subfusoid; apothecia with a gelatinous layer within cortical region .... *C. insititia*
3'. Hairs slender, prominent, evenly distributed on receptacle surface, apothecia without a gelatinous layer in cortical region; ascospores lemon-shaped .... *C. sinensis*
    4. Hairs arising from medullary excipulum, evenly distributed on receptacle surface; paraphyses exceeding the asci only slightly or not .... *C. tricholoma*
    4'. Hairs arising from ectal excipulum, formed in rows on receptacle surface and parallel to the margin of the disc; paraphyses sometimes setose, exceeding asci .... *C. speciosa*
5. Ascospores smooth, apothecia with a gelatinous layer in the inner cortical region .... *C. colensoi*
5'. Ascospores with longitudinal markings, gelatinous layer lacking .... *C. indica*

Cookeina colensoi (Berk.) Seaver, Mycologia 5: 191, 1913.
= *Boedinopeziza colensoi* (Berk.) Korf et Erb Phytologia 21:202, 1971
= *Peziza colensoi* Berk., Hooker's Fl. New Zealand 2: 200, 1855.

Diagnostic features: Apothecia cupulate, subsessile to stipitate, 5-19 mm in diam when dry, receptacle surface smooth; gelatinous layer present in the inner ectal excipulum, 40-50 um thick, cells of axes somewhat perpendicular to receptacle surface; asci suboperculate, 330-360 x 12.5-13 um; ascospores subfusoid-ellipsoid, smooth-walled, 27-30 x 10.5-12 um, biguttulate or 3-guttulate.

Specimens examined: on the ground in broadleaf forest, Lijiang, Yunnan, S.-j. Han & L.-y. Chen (5161), 13 XI 1958, HMAS 27639; Ceheng, Guizhou, Q.-z. Wang (280), 5 IX 1958, HMAS 33607; Guizhou, Y. Li, Y.-c. Zong & J.-z. Ying (613), 4 VIII 1988, HMAS 59537.

Notes: The species with an ectal excipulum containing angular cells is similar to *C. insititia* in a distinct gelatinized layer in the inner ectal excipulum. It is different from *C. insititia* in ellipsoid instead of fusoid ascospores and from *C. indica* by lacking of striations on spore surface. Rifai (1968) failed to mention the gelatinous layer present in this species when he studied the Australasian material. Under the light microscope, some hair-like structure can be seen on the receptacle surface, which are extensions of ectal excipular cells and reach a few cells in length. Seaver (1928), Thind & Batra (1957), and Teng (1963) erroneously described striate ascospores in this species. Re-examination of the specimens identified by Teng reveals that ascospores were smooth-walled. Specimens cited by other authors are not seen.

Cookeina indica Pfister & R. Kaushal, Mycotaxon 20(1): 117-121, 1984. (Fig. 1)

Diagnostic features: Apothecia deeply discoid, up to 15 mm in diam, sessile to stipitate, stalks less than 4 mm long; hymenium Ochraceous-Oray, receptacle concolorous with or lightly darker than the hymenium when dry, surface smooth; ectal excipulum of textura angularis, about 50-70 um thick, with some hair-like structures made up of several cells; medullary excipulum

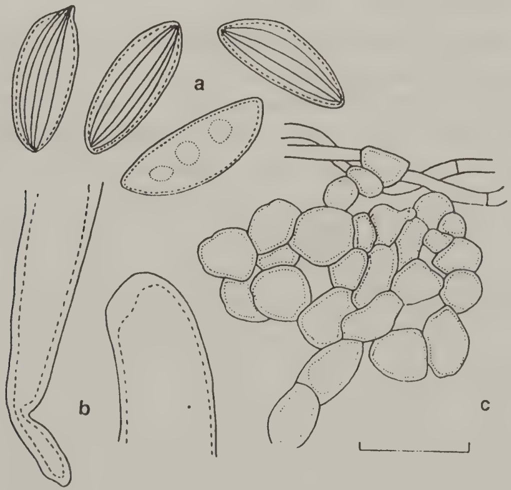

Fig. 1. *Cookeina indica:* **a**, ascospores; **b**, ascus apex and base; **c**, ectal excipular structure; from HMAS 70087, scale = 20 um.

of textura intricata, about 175 um thick; asci (290-)320-350 (370) x (12.5-)5-18(-20) um; ascospores ellipsoid to subfusoid, 3-guttulate, surface with longitudinal ridges, 27.5-35 x 10-13 um.

Specimens examined: on withered twigs, Ceheng, Guizhou, Q.-z. Wang (282), 5 IX 1958, HMAS 27644; on withered twigs, 55 km mark in road to Mongyang, Xishuangbanna, Yunnan, R. P. Korf, M. Zang & W.-y. Zhuang (258), 23 X 1988, HMAS 70087; Xiaguan, Yunnan, Q.-x. Wu (560), 24 VIII 1985, HMAS 71771; on twigs, Yunnan, Y. Li (219), HMAS 70102.

Notes: This is a new record of China. Compared with the Indian material, apothecia of the Chinese collections are subsessile to shortly stipitate. Stipes are not well-devoloped. Pfister & Kaushal (1984) pointed out that apothecia of this species have a furfuraceous margin. Some hair-like extensions similar to those in *C. colensoi* can be detected. Other characters are identical with the Indian collections.

Cookeina insititia (Berk.& M.A.Curtis) Kuntze, Rev. Gen. Pl. 2: 849, 1891.

= *Peziza insititia* Berk. & M.A.Curtis, Proc. Am. Acad. Arts and Sci 4: 127, 1861.

= *Boedijnopeziza insititia* (Berk. & M.A.Curtis) S. Ito & S. Imai, Trans. Sapporo Nat. Hist. Soc. 15: 58, 1937.

Diagnostic features: Apothecia deeply cupulate, 3-6 mm in diam when dry; ectal excipulum of textura subglobulosa to textura angularis, with a gelatinous layer about 40-85 um thick in ectal excipulum; triangular scale-like hairs arising from ectal excipulum forming several rings along apothecial margin, less than 4 mm long; medullary excipulum of textura intricata, 45-100 um thick; hymenium about 380-430 um; asci 400-440 x 13-17 um; ascospores fusoid, multiguttulate, 45-53.5 x 9-13 um.

Specimens examined: Lingao, Hainan, X.-k. Deng (4954), 2 X 1934, HMAS 07149; on wood, Danxian, Hainan, X.-k. Deng (5790), 30 X 1934, HMAS 07185; on wood, Dingan, Hainan, X.-k. Deng (6681), 18 XI 1934, HMAS 07284; Longlin, Guangxi, L.-w. Xu (588), 30 X 1957, HMAS 21228;Tianlin, Guangxi, L.-w. Xu (137), 27 XI 1957, HMAS 21420; Tianlin, Guangxi, L.-w. Xu (136), 27 XI 1957, HMAS 21421; Longlin, Guangxi, L.-w. Xu (803), 1 XI 1957, HMAS 21422; Longlin, Guangxi, L.-w. Xu (434), 26 X 1957, HMAS 21423; Longlin, Guangxi, L.-w. Xu (805), 5 XI 1957, HMAS 24077; Longlin, Guangxi, L.-w. Xu (574), 29 X 1957, HMAS 24078; Longlin, Guangxi, L.-w. Xu (899), 14 XI 1957, HMAS 24079; Longlin, Guangxi, L.-w. Xu (802), 5 XI 1957, HMAS 24080; Longlin, Guangxi, L.-w. Xu (804), 5 XI 1957, HMAS 24081; Longlin, Guangxi, L.-w. Xu (691), 31 X 1957, HMAS 24082; Longlin, Guangxi, L.-w. Xu (864), 12 XI 1957, HMAS 24083; on rotten wood, Ceheng, Guizhou, Q.-z. Wang (264), 6 X 1958, HMAS 26785; on rotten wood, Baoting, Hainan, J.-h. Yu & J.-c. Xing (503), 18 X 1958, HMAS 27640; on rotten wood, Ceheng, Guizhou, Q.-z. Wang (455), 5 X 1958, HMAS 27641; on rotten wood, Longjin, Guangxi, G.-z. Jiang (407), 9 IX 1958, HMAS 27642; Longlin, Guangxi, L.-w. Xu (718), 5 XI 1957, HMAS 30700; Wanning, Hainan, J.-h. Yu & R. Liu (3025), 12 XII 1960, HMAS 30737; on rotten wood, Medog, Xizang, X.-l. Mao (360), 9 IX 1982, HMAS 53400; on wood, 55 km mark in road to Mongyang, Xishuangbanna, Yunnan, R. P. Korf, M. Zang & W.-y. Zhuang (257), 23 X 1988, HMAS 70076; on wood, Endangered Plant Collections, Xishuang-banna Yunnan, R. P. Korf, W.-y. Zhuang et al. (317), 25 X 1988, HMAS 70078; on rotten wood, Luchun, Yunnan, M. Zang (253), 2 X 1973, HKAS 253; on rotten wood, Menlen, Yunnan, M. Zang (7240), 17 X 1980, HKAS 7240; on rotten wood, Menyang, Yunnan, M. Zang, 18 X 1980, HKAS 7256; on rotten wood, Modog, Xizang, Y.-g. Su (2183), 6 II1982, HKAS 16167; on rotten wood, Menlen, Yunnan, M. Zang (11531), 24 X 1988, HKAS 20380.

Notes: This is a very common species in China. Fusoid, smooth-walled ascospores distinguishs this fungus from other species of the genus.

Cookeina sinensis Z. Wang, **sp. nov.** (Fig. 2)

Ab *Cookeina colensoi* pilis longissimis, excipulis ectalibus non gelatinosis, apotheciis grandibus differt. Ab *Cookeina tricoloma* ascosporis laevibus, paraphysibus moniliformibus differt.

Apothecia solitary, cupulate, stipitate, up to 25 mm high and 50 mm in diam when dry, humenium Ochraceous-Orange to Raw Sienna, receptacle Cinnamon-Buff when dry; conspicuously hairy; hairs fasciculate, arising from medullary excipulum, stiff, bristle-like, up to 6-7 mm long; ectal excipulum of textura angularis, about 50 um thick, cells thick-walled, hyaline, 7-13 x 15-25 um; medullary excipulum of textura intricata, 230-300 um thick; asci suboperculate, 8-spored, long cylindrical, narrow-hyphoid at base, thick-walled, J- in Melzer's reagent, 280-290 x 16-17 um; ascospores smooth-walled, subfusoid to lemon-shaped, biguttulate with droplets up to 9 um in diam, 25-28 x 12-12.5 um; paraphyses moniliform, anastomosing and septate.

Holotype: on twig, Xishuangbanna, Yunnan, Y. Li (372), 8 VI 1986, HMAS 70088.

Paratype: on rotten wood, Menlen, Yunnan, M. Zang (10398), 15 VIII 1985, HKAS 14679.

Notes: Compared with other species in the genus, The new species has large apothecia which are up to 50 mm in diameter when dry, smooth ascospores, conspicuous hairs arising from medullary excipulum, and obviously moniliform paraphyses. It is similar to *C. colensoi* in smooth-walled ascospores but quite different from that fungus in its non-gelatinous ectal excipulum and presence of hairs. It is similar to *C. tricholoma* in hair morphology, but different from the later in its smooth-walled ascospores.

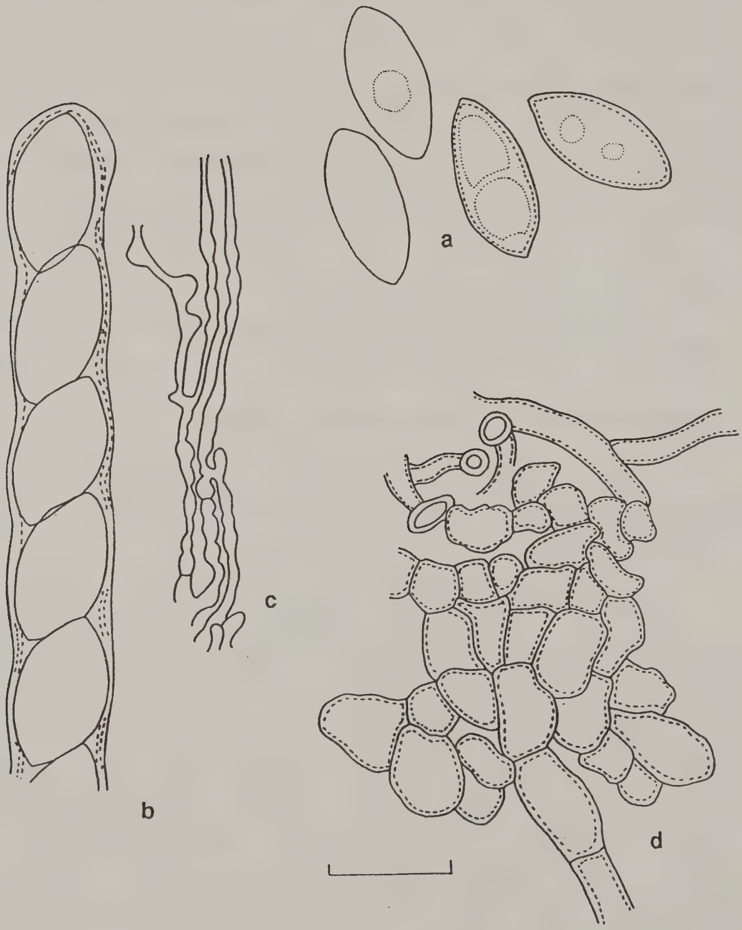

Fig. 2. *Cookeina sinensis:* **a,** ascospores; **b,** ascus apex; **c,** Portion of paraphyses; **d,** ectal excipular structure; from HMAS 70088, scale = 20 um.

Cookeina speciosa (Fr. : Fr.) Dennis, Mycotaxon 51: 237-239, 1995.
≡ *Peziza speciosa* Fr., Syst. Mycol. 2: 84, 1822.
= *Cookeina sulcipes* (Berk.) Kuntze, Rev. Gen. Pl. 2: 849, 1891.

Diagnostic features: Apothecia funnel-shaped, stipitate, rarely sessile, margin covered with fine, inconspicuous hairs; hairs fasciculate, less than 3 mm long; asci 300-400 x 17-20 um; ascospores ellipsoid, biguttulate, surface with fine longitudinal ridges, (22-)25-29 x (11.5-)13-15 um.

Specimens examined: Hainan, G.-z. Jiang (8142), 6 VII 1956, HMAS 19391; on withered twigs, Xishuangbanna, Yunnan, S.-j. Han & L.-y. Chen (5343), 31 X 1958, HMAS 27643; on rotten wood, Diaoluoshan, Hainan, R.-y. Zheng et al. (111), 24 IX 1958, HMAS 27645; on rotten wood, Baoting, Hainan, J.-h. Yu & J.-c. Xing (445), 15 X 1958, HMAS 27646; on rotten wood, Xishuangbanna, Yunnan, S.-j. Han & L.-y. Chen (5343), 5 XI 1958, HMAS 27652; on rotten wood, Baoting, Hainan, J.-h. Yu & R. Liu (1980), 6 VIII 1960, HMAS 28065; Diaoluoshan, Hainan, J.-h. Yu & R. Liu (2727), 31 X 1960, HMAS 29375; on rotten wood, Wanning, Hainan, J.-h. Yu & R. Liu (3022), 12 XII 1960,HMAS 30701; Hainan, J.-h. Yu & R. Liu (2505), 24 IX 1960, HMAS 33608; Menglun, Yunnan, S.-x. Sun et al. (259), 25 VIII 1992, HMAS 61346; on wood, Endangered Plant Collections, Xishuangbanna, Yunnan, R. P. Korf, W.-y. Zhuang et al. (312), 25 X 1988, HMAS 70079; on rotten wood, Menlen, Yunnan, M. Zang 31 VIII 1974, HKAS 1015.

Notes: This is a very common species in the genus. The hymenium-hairs-like paraphyses are obvious. Hairs arise from the ectal excipulum.

Cookeina tricholoma (Mont.) Kuntze, Rev. Gen. Pl. 2: 849, 1891.

Diagnostic features: Apothecia goblet to funnel-shaped, stipitate, conspicuously hairy; hairs stiff, bristle-like, fasciculate, up to 5 mm long; asci 280-350 x 13-18 um; ascospores pointed-ellipsoid, surface with fine, longitudinal ridges, biguttulate, 25-35 x 11-13.5 um.

Specimens examined: Tanhsien, Hainan, S. C. Teng (5818), 31 X 1934, HMAS 09339; on rotten wood, Longjin, Guangxi, G.-z. Jiang (434), 9 IX 1958, HMAS 27647; on rotten wood, Baoting, Hainan, J.-h. Yu & J.-c. Xing (435), 14 X 1958, HMAS 27648; on rotten wood, Xishuangbanna, Yunnan, S.-j. Han & L.-y. Chen (5366), 1 XI 1958, HMAS 27649; on rotten wood, Baoting, Hainan, J.-h. Yu & J.-c. Xing (444), 15 X 1958, HMAS 27650; on rotten wood, Diaoluoshan, Hainan, R.-y. Zheng et al. (186), 26 IX 1958, HMAS 27651; Qiongzhong, Hainan, J.-h. Yu & R. Liu (2503), 24 IX 1960, HMAS 29376; Diaoluoshan, Hainan, J.-h. Yu & R. Liu (2654), 24 X 1960, HMAS 30702; Menglun, Yunnan, S.-x. Sun et al. (259A), 25 VIII 1992, HMAS 61348;

Mengla, Yunnan, S.-x. Sun & X.-j. Liu (145), 22 VIII 1992, HMAS 62988; on wood, Xishuangbanna, Yunnan, J.-y. Zhuang (XB-32), 14 IX 1987, HMAS 70077; on twig, Xishuang-banna, Yunnan, Y. Li (363), 8 VI 1986, HMAS 70081; on rotten wood, Mengla, Yunnan, M. Zang (12302), 14 VIII 1994, HKAS 28193.

Notes: There are abundant collections of this species from China. Hairs arise from the medullary excipulum and are evenly distributed on the receptacle surface. Ascospores have distinct striations.

DISCUSSION

There were two different view points of taxonomy at the generic rank in the past. One is represented by Le Gal (1953), Pfister & Kaushal (1984), and Eriksson & Hawksworth (1993). They admitted only one genus, *Cookeina* Kuntze to include the species with both smooth and striate ascospores and with both gelatinous and non-gelatinous layer in the ectal excipulum and treated *Boedijnopeziza* S. Ito & S. Imai as a synonym. Another was represented by Rifai (1968) and Korf (1971, 1973). They accepted *Boedijnopeziza* for *Cookeina insititia* (Berk. & M. A. Curtis) Kuntze and *Cookeina colensoi* (Berk.) Seaver, two species with smooth ascospores and a gelatinous layer in the ectal excipulum. Rifai (1968) emphasized the phenomenon that the aperture of the apothecium in *B. insititia* (Berk. & M. A. Curtis) S. Ito & S. Imai (= *C. insititia*) is closed by a nearly continuous subconial sheath, which by expansion of the cup ruptures radiately and gives rise to a ring of hairs. Pfister (1978) did not observe the membrane covering the hymenium in this fungus, a structure made up of hairs like that membrane is present in specimens from China, which is not a real membrane.

According to the key given by Korf (1973), the species with smooth-walled ascospores and a gelatinous ectal excipulum should belong to *Boedijnopeziza* and those with striate ascospores and non-gelatinous ectal excipulum should be members of *Cookeina*, then the placement of *Cookeina sinensis* becomes paradoxical. This led me to revalue the acceptability of the genus *Boedijnopeziza* and the two main characters used to distinguish *Boedijnopeziza* from *Cookeina*. In my opinion, *Cookeina sinensis* Z. Wang together with *C. venezuelae* (Berk. & M. A. Curtis) Le Gal which has striate ascospores and a gelatinous ectal excipulum can be treated as transition in *Cookeina* from species with smooth-walled ascospores and a gelatinous ectal excipulum (features of *Boedijnopeziza* by some authors) to the members with striate ascospores and non-gelatinous ectal excipulum (features of *Cookeina* in a narrow sense) and supports that *Cookeina* and *Boedijnopeziza* should be united.

In addition, When the Chinese material of *Cookeina speciosa* (Fr. : Fr.) Dennis were examined, the inner side of the ectal excipulum and outer side of the medullary excipulum seem to be somewhat gelatinous. This indicates that the presence of gelatinous layer might not be critical in taxonomy of these group of fungi.

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REFERENCES

Denison, W. C. (1967) Central American Pezizales. II. The genus *Cookeina*. *Mycologia* **59**: 306-317.

Eriksson, O. E. & D. L. Hawksworth (1993) Outline of the Ascomycetes-1993. *Syst. Ascom.* **12**: 51-126.

Korf, R. P. (1971) Some new discomycete names. *Phytologia* **21:** 201-207.

Korf, R. P. (1973) Discomycetes and Tuberales. pp: 249-319. In G. C. Ainsworth, A. S. Sussman and F. K. Sparrow (*eds.*), *The Fungi: An Advanced Treatise* **4A**. Academic Press. New York & London.

Le Gal, M. (1953) Les discomycetes de Madagascar. *Prod. Flore Myc. Madagascar* **4**: 1-465.

Pfister, D. H. (1973) Notes on Caribbean Discomycetes. *Phytologia* **27**: 55-62.

Pfister, D. H. (1978) Apothecial development in *Cookeina tricholoma* with comments on some related species. *Mycologia* **70**: 1253-1257.

Pfister, D. H. & R. Kaushal (1984) *Cookeina indica,* a new species from India with a key to the species of *Cookeina*. *Mycotaxon* **20**: 117-121.

Ridgway, R. (1912) *Color Standards and Color Nomenclature*. Ridgway. Washington, D.C.

Rifai, M. A. (1968) The Australasian Pezizales in the Herbarium of the Royal Botanic Gardens, Kew. *Verh. Kon. Ned. Akad. Wetensch. Afd. Natuurk,* Tweede Sect. **57(3)**: 1-295.

Seaver, F. J.(1928) *The North American Cup-fungi (Operculates)*. Seaver. New York.

Tai, F. L. (1979) *Sylloge Fungorum Sinicorum.* Science Press. Beijing. (in Chinese)
Teng, S. C. (1935) Supplement notes on Ascomycetes from China. *Sinensia* **6**:185-218.
Teng, S. C. (1936) Supplement notes on Ascomycetes from China II. *ibid* 7: 194-211.
Teng, S. C. (1939) *A Contribution to our Knowledge of the Higher Fungi of China.* Nat. Ins. Zool. Bot. A. C. Yangso.
Teng, S. C. (1963) *Fungi of China.* Science Press. Beijing. (in Chinese)
Thind, K. S. & L. R. Batra (1957) The Pezizaceae of the Mussoorie hills -- IV. *J. Indian Bot. Soc.* **36**: 436-438.

中国毛杯菌属分类研究

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摘要：本文讨论了中国毛杯菌属在分类研究的状况，描述了中国已知种的关键特征，部分种给出了图示 并提供了分种检索表。中国毛杯菌 (*Cookeina sinensis*) 是该属的一个新种，印度毛杯菌 (*Cookeina indica*)是中国的新记录种。本文还为勃氏盘菌属(*Boedijnopeziza*) 作为毛杯菌属 (*Cookeina*) 的异名提供了证据。

关键词：毛杯菌属，中国毛杯菌，印度毛杯菌，中国

MYCOTAXON

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A NEW *MYCENA* FROM NEW YORK

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Abstract: *Mycena eburnea* var. *roseidisca* is described as new, differing from var. *eburnea* in forming a pileus with rosy pink disc, a grey to brownish grey stipe, raphanoid odor, rare pleurocystidia and broader basidiospores.

Keywords: Agaricales, *Mycena*, taxonomy

Recent fieldwork by the second author yielded an undescribed variety of a rarely encountered *Mycena*. *Mycena eburnea* var. *eburnea* Maas Geesteranus (1988a) is known at present from only two specimens collected from the same population at Higgins Lake, Michigan in May, 1945. *Mycena eburnea* var. *roseidisca*, described below, is known at present from a single population in a similar habitat at Oneida Lake, New York.

Mycena eburnea Maas Geesteranus var. ***roseidisca*** Desjardin et Bessette *var. nov.* Figs. 1-6

A var. eburneus differt pileo disco roseo, stipite griseo vel brunneogriseo, odore raphano et sporis 8-10 X 5.7-7 µm. Holotypus: Bessette no. B10502 (SFSU).

Basidiomata (Fig. 1) fragile, putrescent. **Pileus** 10-15 mm diam, obtusely conic to convex when young, expanding with age to broadly obtusely conic; margin striate, even when young,

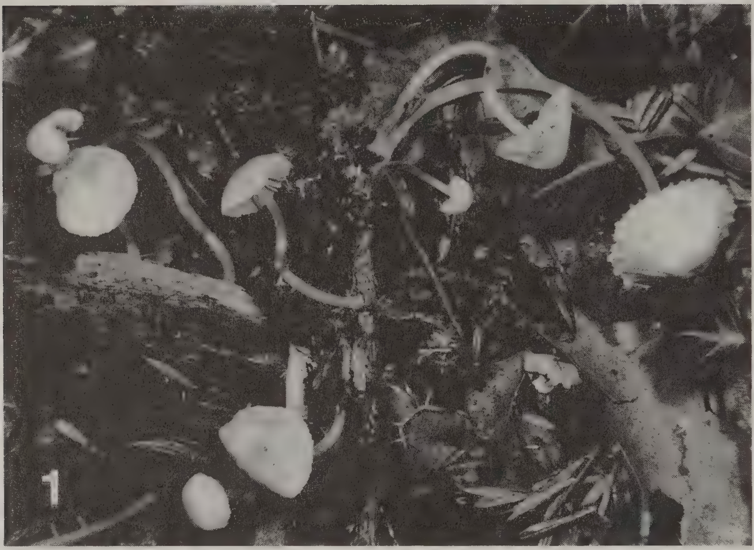

Fig. 1. Basidiomata of *Mycena eburnea* var. *roseidisca* (x1.5).

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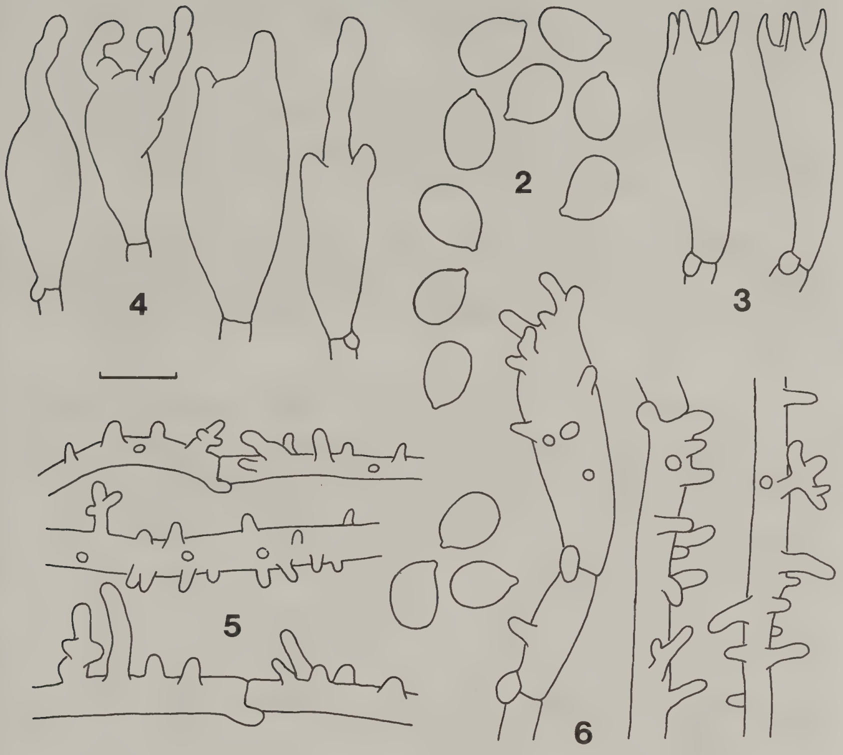
becoming crenate in age; surface dull, dry, glabrous; disc rosy pink and margin white throughout maturation. **Context** thin (<1 mm), white. **Odor and taste** mildly raphanoid. **Lamellae** ascending, narrowly adnate, subdistant (16-20) with 1-2 series of lamellulae, narrow, convex, white throughout development (never pink), non-marginate. **Stipe** 20-30 X 1 mm, central, terete, equal, hollow, subshiny, dry, glabrous or minutely pruinose above, sparsely white-tomentose below; apex white when young, becoming pale greyish white in age; central portion and base grey to brownish grey throughout development.

Basidiospores (Fig. 2) 8-10 X 5.7-7 µm [$\bar{x}$ = 9.0 ± 0.5 X 6.3 ± 0.4 µm, Q = 1.2-1.7, $\bar{Q}$ = 1.4 ± 0.1, n = 20 spores], ovoid to broadly ellipsoid, smooth, hyaline, thin-walled, amyloid, white in deposit. **Basidia** (Fig. 3) 27-35 X 8-10 µm, clavate, 4-spored, clamped. **Cheilocystidia** (Fig. 4) common, 22-45 X 8-15 µm, versiform, irregularly cylindrical, subclavate, clavate or fusiform, apically tapered to a long narrow neck or with 1-3 irregularly cylindrical projections, hyaline, thin-walled, non-



Figs. 2-6. *Mycena eburnea* var. *roseidisca*. 2. Basidiospores. 3. Basidia. 4. Cheilocystidia. 5. Pileipellis hyphae. 6. Stipe cortical hyphae. Scale bar = 10 µm (x1000).

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gelatinous. **Pleurocystidia** absent or rare and then like the cheilocystidia. **Pileipellis** a cutis of sparsely diverticulate hyphae (Fig. 5); hyphae 2.5-7 µm diam, cylindrical, hyaline, non-gelatinous, non-incrusted, inamyloid; diverticula 2-8(-10) X 1-2 µm, clustered to scattered, cylindrical, obtuse, hyaline, non-gelatinous. **Hypodermium** of inflated, dextrinoid hyphae. **Hymenophoral trama** regular, non-gelatinous, dextrinoid. **Stipe tissue** monomitic; cortical hyphae (Fig. 6) 2.5-6.5 µm diam, cylindrical, parallel, covered with cylindrical and often branched diverticula 1.5-13 X 1.5-3 µm; terminal cells repent to suberect, 6-10 µm diam, diverticulate; medullary hyphae 4-16 µm diam, cylindrical to slightly inflated, hyaline, with scattered hyaline oleiferous hyphae interspersed. **Clamp connections** present in all tissues.

Habit, habitat and distribution. Scattered to gregarious on decaying wood and humus in mixed woods of maple, beech, hemlock and pine.

Material Examined. UNITED STATES: New York, Oswego Co., Cleveland, Vanderkamp, north shore of Oneida Lake, 16 Sept. 1995, A. Bessette no. B10502 (Holotype – SFSU; Isotype – NY).

Commentary. *Mycena eburnea* was first described by A. H. Smith as *Mycena alcalina* forma *alba* A. H. Smith (1953), based on material collected from a single population on a conifer log at Higgins Lake, Michigan. It is apparently a rare taxon, known at present from only two specimens collected the same month from the same log. The pileus and stipe were described as white and the odor alkaline. Maas Geesteranus (1988a) redescribed the taxon and elevated it to species rank [*non Mycena alba* (Bres.) Kühn., Encycl. Mycol. 10: 594. 1938.], placing it in sect. *Fragilipedes* (Fr.) Quélet. He chose the epithet "*eburnea*" because notes with one of the two known specimens reported the pileus as "ivory white". Micromorphologically, var. *roseidisca* is nearly identical to var. *eburnea*, differing only subtly in basidiospore shape and size, and abundance of pleurocystidia The basidiospores of var. *eburnea* are ellipsoid, 8-10.5 X 5-6 µm [$\bar{x}$ = 9.0 X 5.6 µm, $\bar{Q}$ = 1.6; Holotype (MICH!)] and pleurocystidia are very common and conspicuous, while the basidiospores of var. *roseidisca* are more ovoid, 8-10 X 5.7-7 µm ($\bar{x}$ = 9.0 X 6.3 µm, $\bar{Q}$ = 1.4) and pleurocystidia are absent or rare (and then present only nearest the lamellar edges). Macromorphologically, the two taxa differ in pileus and stipe pigmentation and odor. The pileus disc of var. *roseidisca* is distinctly and consistently rosy pink, the stipe is grey to brownish grey, and the odor is raphanoid.

Maas Geesteranus (1988b) compared *M. eburnea* with *M. subincarnata* (Peck) Sacc. because of their micromorphological similarities, and he provided a table itemizing their diagnostic features. A comparison of *M. eburnea* var. *roseidisca* with *M.*

subincarnata is likewise warranted. Although the pileus of *M. subincarnata* was described as flesh-colored and hence similar to the rosy pink disc of var. *roseidisca*, the lamellae were described as subincarnate, not white as in var. *roseidisca*. Unfortunately no mention of stipe coloration was reported by Peck (1872) or Maas Geesteranus (1988b). More significantly, *Mycena subincarnata* differs in forming much smaller basidiospores (7.2-8.1 X 3.5-4.4 µm; syntype), cheilocystidia of a different shape (*i.e.*, with more numerous and smaller apical projections), abundant lageniform to fusiform pleurocystidia, and stipe cortical hyphae with shorter (1-3.5 µm), unbranched diverticula (*fide* Maas Geesteranus, 1988b).

LITERATURE CITED

Maas Geesteranus, R. 1988a. Conspectus of Mycenas of the Northern Hemisphere – 9. Section *Fragilipedes*, species A-G. Proceedings C 91(1): 43-83.

________. 1988b. Conspectus of Mycenas of the Northern Hemisphere – 9. Section *Fragilipedes*, species S-Z. Proceedings C 91(3): 283-314.

Peck, C. H. 1872. Report of the botanist. Ann. Rep. New York State Cab. 23: 27-135.

Smith, A. H. 1953. New and rare agarics from the Douglas Lake region and Tahquamenon Falls State Park, Michigan, and an account of the North American species of *Xeromphalina*. Pap. Michigan Acad. Sci. 38: 53-87.

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NEW RECORDS OF POLYPORES (APHYLLOPHORALES) FROM SOUTHERN BRAZIL

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ABSTRACT

In a survey of polyporoid fungi (Aphyllophorales) from Lagoa da Conceição Hill, Santa Catarina Island (27°10'and 27°50'S lat. and 48°25' and 48°35'W long.) 33 species were recorded. Six of them are new records for Santa Catarina State: *Phellinus rhabarbarinus*, *Flaviporus subhydrophilus*, *Pachykytospora papyracea*, *Polyporus infernalis*, *Rigidoporus ulmarius* and *Tyromyces leucomallus*. *Ganoderma annularis* and *Flaviporus brownei* are new records for Santa Catarina Island and *Phellinus allardii* is a new record for Brazil.

KEY WORDS: Aphyllophorales, New Records, Polyporoid fungi, Taxonomy

INTRODUCTION

Lagoa da Conceição Hill (27°42'S and 48°30'W), Santa Catarina Island (Southern Brazil) is a crystalline geological formation (Upper Pre-Cambrian), 490 m high (Caruso, 1990). From a biogeographical standpoint it can be considered as pertaining to the Neotropical region of the American Dominion in the Atlantic zone (Cabrera & Willink, 1973). The vegetation corresponds to the Atlantic Rain Forest in a secondary stage. It is placed within a mesotherm humid climate with rains uniformly distributed throughout the year, with hot summers (Caruso, 1990). In a former study (Loguercio-Leite & Wright, 1991) on the mycota of Santa Catarina Island 67 species of Aphyllophorales, distributed in the Ganodermataceae (2 spp.), Hymenochaetaceae (15 spp.) and Polyporaceae (50 spp) were found, many of them the first record for Brazil.

MATERIALS AND METHODS

Intensive collecting was undertaken each month (June 1993 - June 1994) on the Island in order to contribute to a better knowledge of subtropical polypores. Measurements and drawings were made from freehand sections mounted in 1% phloxine solution + 5% KOH solution and Melzer's reagent. Colours are those of Munsell (1975). The collections considered in this survey are deposited in Herbarium FLOR, and were compared with materials of FLOR (Florianópolis, Brazil), ICN (Porto Alegre, Brazil) as well as BAFC (Buenos Aires, Argentina). Herbarium designations are those Holmgren & Keuken (1974). Distribution data are from specimens cited and Ahmad (1972), Cunningham (1965), Gilbertson & Ryvarden (1986, 1987), Ginns (1980), Gugliota & Capelari (1995), Jesus (1996), Lowe (1966, 1975), Rajchenberg & Wright (1987), Ryvarden & Johansen (1980), Silveira & Guerrero (1991) and Zhao (1989).

RESULTS AND DISCUSSION

Ganoderma annularis (Fr.) Gilbn. Fig. 1
Mycologia 53: 505. 1961

≡ *Polyporus annularis* Fr., Nov. Symb. Mycol., p. 52. 1885.

Basidiocarp pileate, flabeliform, applanate, 8.5 x 6 cm x 2.4 cm. Pileus surface concentrically sulcate, glabrous, non laccate, strong brown (4/6 7.5YR). Margin obtuse, entire, thick, sterile zone 2 mm wide, pale yellow (7/4 2.5Y). Pore surface concolorous with the margin. Pores circular, 4 - 5 per mm, dissepiments entire; tubes indistinctly stratified, up to 1.9 cm deep, reddish brown (4/3 5YR); context thin up to 5 mm thick at the margin, near the cutis yellowish brown (5/8 10YR), near the tubes dark reddish brown (3/3 5YR).

Hyphal system trimitic; generative hyphae clamped, thin-walled, hyaline, 2.5 - 3 µm diam.; skeletal hyphae thick-walled, brown, 3 - 6 µm diam.; binding hyphae thick-walled, hyaline to pale brown, much branched, 1.5 - 3 µm diam. Pilear crust anamixodermic. Basidiospores ellipsoid, truncate at the apex, wall with two layers separated by interwall pillars, pale brown, 8 - 9.5 x 5 - 6 µm.

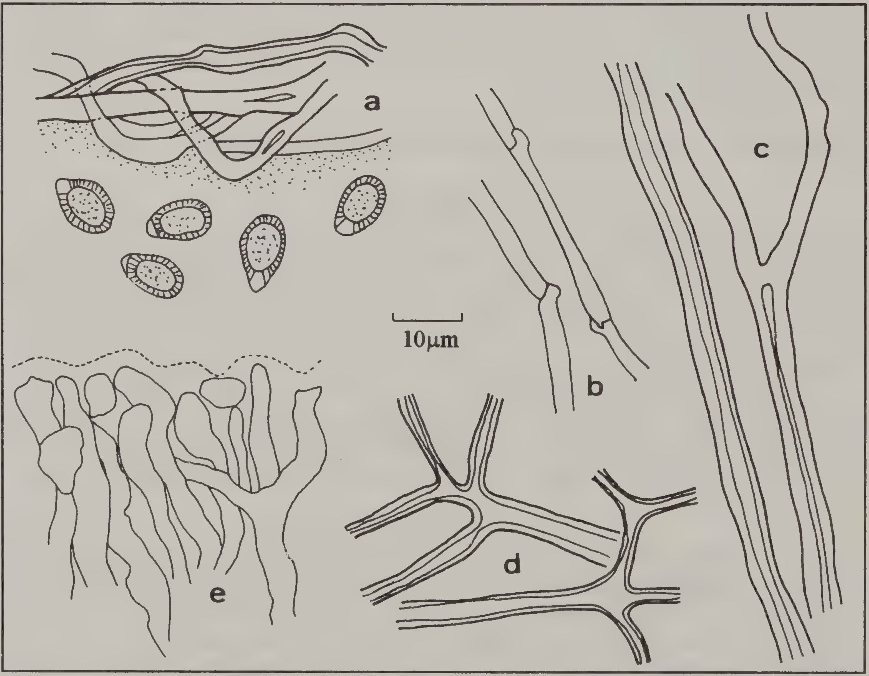

Fig. 1. *Ganoderma annularis*: a. collapsed hymenium, spores; b. generative hyphae; c. skeletal hyphae; d. binding hyphae; e. pilear crust. (FLOR 10947).

Distribution: North America, Brazil (SC) and China.

Material examined: BRAZIL, SC, Ilha de Santa Catarina, Morro da Lagoa da Conceição, Gerber, A. & R. Cabral 324, 12/ XI/93 (FLOR 10947); ibid, Cunha Porã, L. Glória, Halmenschlager, M. A. & R. Foresti 05, 06, 20/I/91 (FLOR 10832, 10833).

Remarks: The spores (8 - 9.5 x 5 - 6μm) are smaller than those recorded by Gilbertson & Ryvarden (1986) as 11 - 14 x 7 - 8 μm and also by Zhao (1989) as 9 - 12 x 6 - 8 μm. Both authors characterized this species by basidiomes with a hard and thick pilear crust, context thin or almost absent and tubes not stratified, similar as those found in our specimens. The measurements of spores are similar to those of *G. applanatum* (Pers.) Pat. given by Zhao (1989), 7 - 9 x 4.3 - 6.2 μm; however, according to Zhao (1989), *G. annularis* differs from *G. applanatum* which has a softer pilear crust, and thick and stratified context. It is important to point out that generally spore size in different species of the genus *Ganoderma* overlaps. In some species the macroscopical characteristics are more important distinguishing features than spore dimensions. New record for Santa Catarina Island.

Phellinus allardii (Bres.) Ahmad Fig. 2
Monogr. Biol. Soc. Pakistan 6: 57. 1972

≡ *Fomes allardii* Bres., Bull. Jard. Bot. Etat. 4: 19. 1910.

Basidiocarp pileate, triquetrous, broadly attached, 2.2 - 7 x 2.2 - 3 cm and up to 6 cm thick. Pileus surface concentrically sulcate and zonate, brown (4/4 7.5YR) to black (2/1 10YR), with a tomentum overlying a distinct black line which is about 0.5 mm thick; the black line may be found in the context or between tube layers. Margin sharp and undulating. Pore surface dark yellowish brown (4/4 10YR). Pores very small, circular, 6 - 10 per mm; tubes distinctly or indistinctly stratified up to 5.5 cm deep, sometimes separated by thin context bands; context strong brown (4/6 7.5YR), very thin.

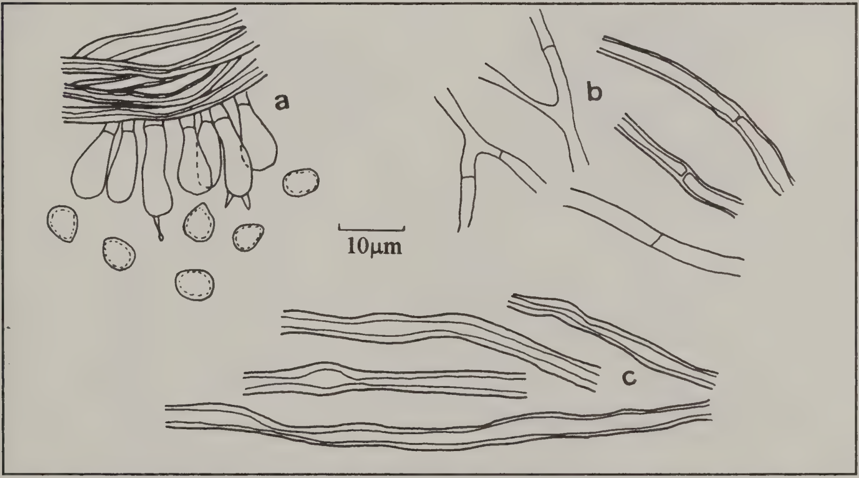

Fig. 2. *Phellinus allardii*: a. hymenium: basidia, basidioles and spores; b. generative hyphae; c. skeletal hyphae. (FLOR 10932)

Hyphal system dimitic; generative hyphae simple-septate, thin to slightly thick-walled, sometimes branched, 1.5 - 2 μm diam.; skeletal hyphae thick-walled, golden to rusty brown, 2 - 3.5 μm diam. Setae none. Basidia clavate 4-sterigmate, 10 - 12 x 4 - 5 μm. Basidiospores broadly ellipsoid to subglobose, thick-walled, pale rusty brown when mature, smooth, 4 - 5 x 3.5 - 4 μm.

Distribution: Africa, Argentina, Brazil (SC) and Pakistan.
Material examined: BRAZIL, SC, Ilha de Santa Catarina, Morro da Lagoa da Conceição, Gerber, A., I. Baptista & R. Cabral 248, 25/VI/93 (FLOR 10932); KENYA, Kanura Forest, Lanbinon, J. 75/225, 12/IV/75 (BAFC s/n°, duplicate of O.).
Remarks: Our spores measurements (4 - 5 x 3.5 - 4 µm) are similar to those of Ahmad (1972) and relatively smaller than those of Ryvarden & Johansen (1980). This species can be confused with *P. nilgheriensis* (Mont.) Cunn. which, however does not exhibit a black line under the tomentum and/or between the tubes and has wider skeletal hyphae (4 - 7 µm) (Ryvarden & Johansen, 1980). New record for Brazil.

Phellinus rhabarbarinus (Berk.) Cunn. Fig. 3
New. Zeal. Dep. Sci. Ind. Res. Bull. 164: 229. 1965.

≡ *Polyporus rhabarbarinus* Berk., Ann. Nat. Hist. 3: 338. 1839.

Basidiocarp pileate, solitary, applanate, broadly attached, 13.2 x 7.6 x 2.5 cm. Pileus surface glabrous, concentrically sulcate, dark reddish brown (3/2, 2.5/2 5YR) to very dark brown (2/2 10YR), in section with a distinct black crust up to 5 mm thick. Margin acute, lobate, concolorous. Pore surface dark brown (3/3 10YR, 3/2 7.5YR). Pores circular, 7 - 9 per mm, dissepiments entire and thick; tubes indistinctly stratified up to 1.5 cm deep, strong brown (4/6 7.5YR); context up to 1 cm thick, brownish yellow (6/8 10YR).

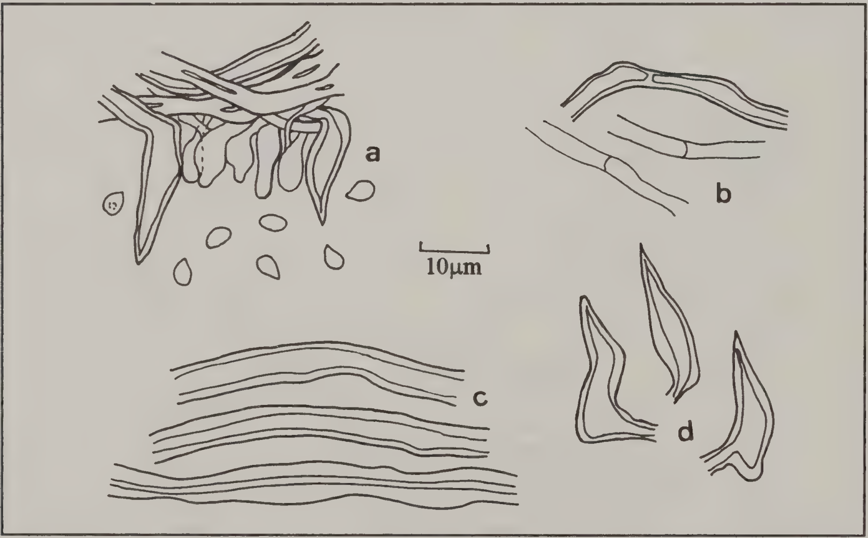

Fig. 3. *Phellinus rhabarbarinus*: a. hymenium: basidioles, spores and setae; b. generative hyphae; c. skeletal hyphae; d. setae. (FLOR 10922).

Hyphal system dimitic; generative hyphae with simple septa, thin to slightly thick-walled, hyaline to yellowish, 2 - 2.5 µm diam; skeletal hyphae thick-walled, golden to brown, 3.5 - 5 µm diam. Hymenial setae ventricose, straight, thick-walled, dark brown, 14 - 22.5 x 5 - 7.5 µm. Basidioles clavate, 8 - 12.5 x 3 - 4.5 µm. Basidiospores broadly ellipsoid, thin-walled, hyaline, smooth, 3 - 4 x 2 - 2.5 (-3) µm.

Distribution: Argentina, Brazil (SC), Fijii and New Guinea.
Material examined: BRAZIL, SC, Ilha de Santa Catarina, Morro da Lagoa da Conceição, Gerber, A. & R. Cabral 318, 12/XI/93 (FLOR 10922); ARGENTINA, Salta, Santa Victoria, Quadrada El Nogalar, Palaú, C. 467, 19/III/86 (BAFC 30716).
Remarks: Larsen & Cobb-Poulle (1990) found in the holotype spores (2.5-) 3 - 3.5 x 2 - 2.5 μm, broadly ellipsoid, very similar of those observed in our materials. Cunningham (1965) did not give measurements of spores, but the size of setae observed (14 - 22 x 6 - 8 μm) are similar to ours. Ryvarden & Johansen (1980) stated that the spores observed were globose (3.5 - 4 μm diam.), and may be a contamination; setae are larger (18 - 30 x 5 - 8 μm) than in our specimens; they characterized the species by a glabrous pileus surface with sulcate zones and a distinctive black line, and brownish yellow context. New record for Santa Catarina State.

Flaviporus brownei (Humb.) Donk Fig. 4
Persoonia, 1: 189. 1960.

≡ *Polyporus brownei* Humb., Flora Frilbergensis, p. 101. 1793.

Basidiocarp pileate, dimidiate or imbricate, 2- 3.6 x 1.5 - 2.4 cm and up 2 mm thick. Pileus surface hard, cracked, glabrous, crustose, reddish yellow (6/8 7.5YR) to dark reddish brown (3/4, 3/2 5YR) with concentric dark reddish brown (2.5/2 5YR) bands. Pore surface yellow (8/8, 7/8 2.5Y). Pores angular, 9 - 11 (-12) per mm; tubes stratified or not, up to 1.5 mm deep, pale yellow (8/4 2.5YR); context up to 0.5 mm thick, concolorous with the tubes.

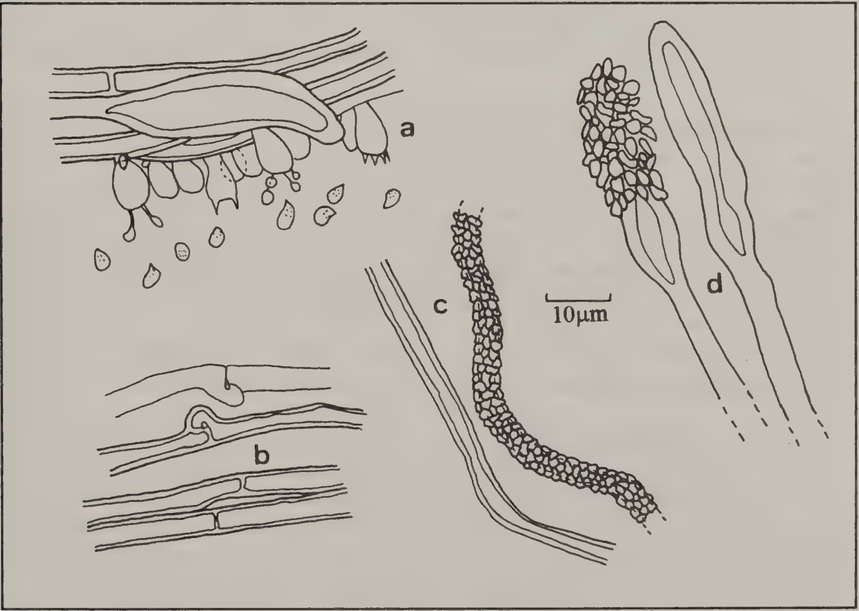

Fig 4. *Flaviporus brownei*: a. hymenium: basidia, basidioles, spores and cystidia; b. generative hyphae; c. skeletal hyphae; d. cystidia. (FLOR 11014).

Hyphal system dimitic, hyphae agglutinated; generative hyphae clamped, occasionally simple-septate, thin to thick-walled, hyaline, 1.5 - 2.5 μm diam; skeletal hyphae thick-walled, finely incrusted in some parts of the trama, 2 - 4 μm diam. Cystidia in the trama abundant, partly projecting into the hymenium, thick-walled, crystalline incrusted at the apex, 6 - 8 μm diam. Basidia claviform, 4-sterigmate, 7 - 9 x 4 - 4.5 (-5) μm. Basidiospores broadly ellipsoid, thin-walled, hyaline, smooth, 2.5 - 3 x 1.5 - 2 μm

Distribution: Australia, Bolivia, Borneo, Brazil (PR, SC, RS), Cuba, Ecuador, French Antilles, Guyana, Jamaica, Juan Fernandez, Malacca, Martinica, Mexico, New Zealand, Sarawak, Sri Lanka, Tristan de Cunha, Venezuela, Zambia; found in glasshouses and mines in Germany and Great Britain; in France and Spain found in nature.

Material examined: BRAZIL, SC, Ilha de Santa Catarina, Morro da Lagoa da Conceição, Gerber, A. , R. Cabral & M. A. Halmenschlager 498, 28/VI/94 (FLOR 11014); ibid, PR, General Carneiro, Fazenda São Pedro, Meijer, A. P. 1289, 08/VI/89 (BAFC 33536).

Remarks: In the field this species is easily recognized by the brown pilear surface and yellow hymenophoral surface, these aspects are distinctive of other species of *Flaviporus*. Spore size is similar to those recorded by Reid (1955) and Ginns (1980): they are broadly ellipsoid. The dimitic hyphal system with agglutinated hyphae and the presence of tramal cystidia with incrusted apex are important characteristics for its recognition. New record for Santa Catarina Island.

Flaviporus subhydrophilus (Speg.) Rajch. & Wright Fig. 5
Mycologia 79(2): 259. 1987.

≡ *Polystictus subhydrophilus* Speg., Bol. Acad. Nac. Cienc. Córdoba 11: 444. 1889.

Basidiocarp pileate, solitary, dimidiate, 2 - 3.6 x 1.5 - 2.4 cm and up to 2 mm thick. Pileus surface glabrous to velutinous, concentrically zonate, yellow (7/6 10YR) to brownish yellow (6/8 10YR) with reddish yellow (6/8 5YR) bands. Margin incurvate when dry, velutinous. Pore surface yellow (7/8 10YR). Pores round to angular, 8 - 9 per mm; tubes up to 1.5 mm deep, concolorous with the pore surface; context up to 1 mm thick, white (8/1 10YR), separated from the pileus surface by a very thin dark line.

Hyphal system dimitic; generative hyphae clamped, thin to slightly thick-walled, hyaline, 2 - 4 μm diam.; skeletal hyphae thick-walled, hyaline, finely incrusted at the edge of the dissepiments, 3 - 6 μm diam. Basidia claviform, 4-sterigmate, 7 - 9.5 x 3.5 - 4 μm. Basidiospores cylindric to ellipsoid, thin-walled, hyaline, smooth, 2.5 - 3 x 1.5 - 2 μm.

Distribution: Brazil (RS, SC, SP).

Material examined: BRAZIL, SC, Ilha de Santa Catarina, Morro da Lagoa da Conceição, Gerber, A. , R. Cabral & M.A. Halmenschlager 502, 28/VI/94 (FLOR 11027): ibid, RS, Cambará do Sul, Itaimbezinho, Silveira, R. M. & R.T. Guerrero 204, 30/IV/89 (ICN 56973).

Remarks: Rachjenberg & Wright (1987) gave the size of spores of the holotype as 3.5 - 4 μm; our measurements agree with those Silveira & Guerrero (1991) (2.7 - 3.6 x 1.5 - 2 μm). *F. subhydrophilus* does not exhibit agglutinated hyphae in the context and cylindric spores differing from other species in the genus. New record for Santa Catarina State.

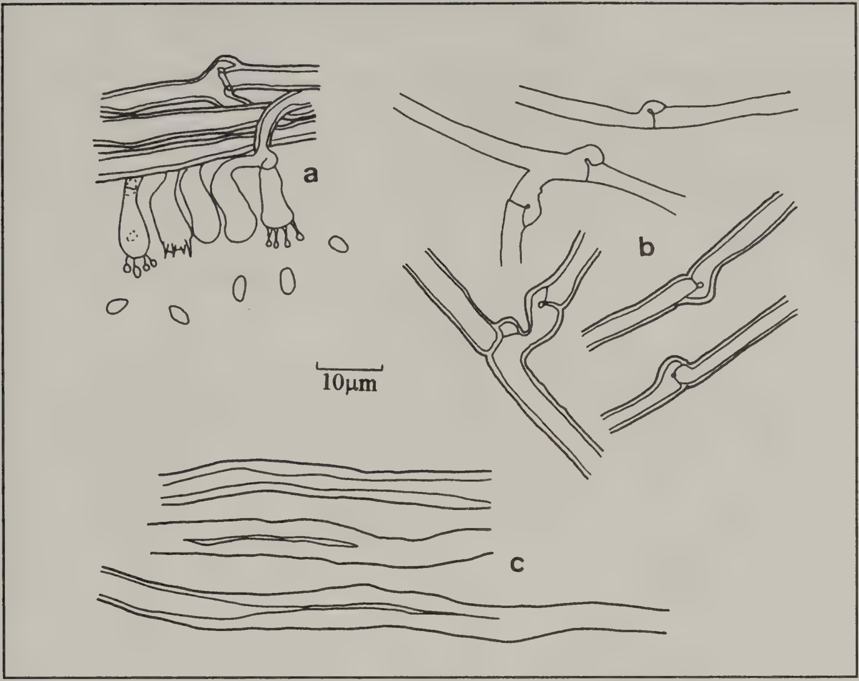

Fig. 5. *Flaviporus subhydrophilus*: a. hymenium: basidia, basidioles and spores; b. generative hyphae; c. skeletal hyphae. (FLOR 11027).

Pachykytospora papyracea (Schw.) Ryv. Fig. 6
Norw. J. Botany 19: 233. 1972.

≡ *Boletus papyraceus* Schw., Natur. Ges. Leipzig Schrift. 1: 99. 1822.

Basidiocarp resupinate, 5 - 8 x 3.3 cm and up to 4 mm thick. Pore surface very pale brown (8/4 10YR) to yellow (7/6, 7/8 10YR). Margin finely tomentose, concolorous. Pores circular to angular (2-) 3 - 4 per mm with thin, entire to dentate dissepiments; tubes up to 3 mm deep, concolorous with the pore surface; context thin, less than 1 mm thick.

Hyphal system dimitic; generative hyphae clamped, thin-walled, hyaline, 2 - 3 (-3.5) µm diam.; skeletal hyphae yellowish in KOH, thick-walled to almost solid, straight to occasionally branched, 3 - 5 µm diam, variably dextrinoid in Melzer's reagent. Dendrohyphidia present at the edge of the dissepments. Basidioles claviform, 15 - 25 x 6 - 8 µm. Basidiospores cylindric to cylindric-ellipsoid, thin-walled, hyaline, ornamented with echinulae arranged in longitudinal rows, appearing longitudinally striate, (12.5-) 13 - 15 (-15.5) x 5 - 6 (-6.5) µm.

Distribution: Australia, Brazil (RS, SC), Burundi, Congo, Kenya, Madagascar, Malawi, New Zealand, North America, Sri Lanka, Tanzania and Zaire.

Material examined: BRAZIL, SC, Ilha de Santa Catarina, Morro da Lagoa da Conceição, Gerber, A., I. Baptista & R. Cabral 247, 25/VI/93 (FLOR 10931), ibid, Gerber, A. & R. Cabral 264, 19/VII/93 (FLOR 10938); ibid, RS, São Leopoldo, Rick 1907 (BAFC 27143).

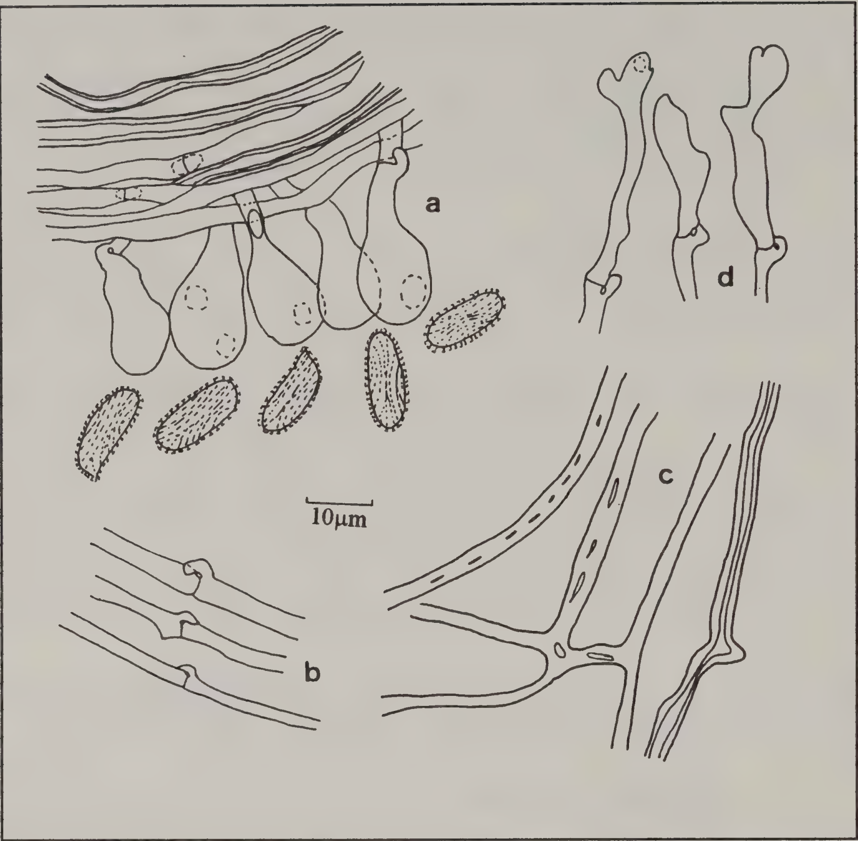

Fig. 6. *Pachykytospora papyracea*: a. hymenium: basidoles and spores; b. generative hyphae; c. skeletal hyphae; d. dendrohyphidia. (FLOR 11931).

Remarks: The specimens examined by us had (2-) 3 - 4 pores/mm; the context hyphae were thicker, the spores longer and wider than in *P. alabamae* (Berk. & Cke.) Ryv., these characteristics are distinctive of *P. papyracea* according to Lowe, 1966; Ryvarden & Johansen, 1980 and Gilbertson & Ryvarden, 1987. There appears to be a continuum in the spore measurements between and *P. papyracea* (Table 1). New record for Santa Catarina State.

Table 1: Resumé of comparative spore measurements of *P. alabamae* and *P. papyracea.*

	P. alabamae	*P. papyracea*
Lowe (1966)	7 - 14 x 3 - 7 μm	10 - 17 x 6 - 8 μm
Ryvarden & Johansen (1980)	9 - 12 x 4 - 6 μm	10 - 13.5 (17) x 6 - 7.5 (8) μm
Gilbertson & Ryvarden (1987)	9.5 - 12.5 x 4 - 5.5 μm	14 - 17 x 6 - 8 μm
Gerber (1994)	10 - 14 x 3 - 4 (5.5) μm	(12.5) 13 - 15 x 5 - 6 (6.5) μm

Polyporus infernalis Berk.
London Journ. Bot. 2: 637. 1843

Fig. 7

Basidiocarp pileate, laterally stipitate, dimidiate, 4 - 6 x 2 - 4 cm and up to 6 mm thick. Pileus surface glabrous, radially striate to wrinkled, dusky red (3/3 10R) to black (2.5/1 5YR) and with a thin cuticle. Pore surface yellowish brown (5/6 10YR). Stipe 5 - 8 mm long, covered by a black crust (2.5/1 5YR) and the hyphal structure very pale brown (8/3 10YR). Pores circular and entire, 4 - 6 per mm; tubes up to 3 mm deep, concolorous with the pore surface; context up to 3 mm thick, very pale brown (8/3 10YR).

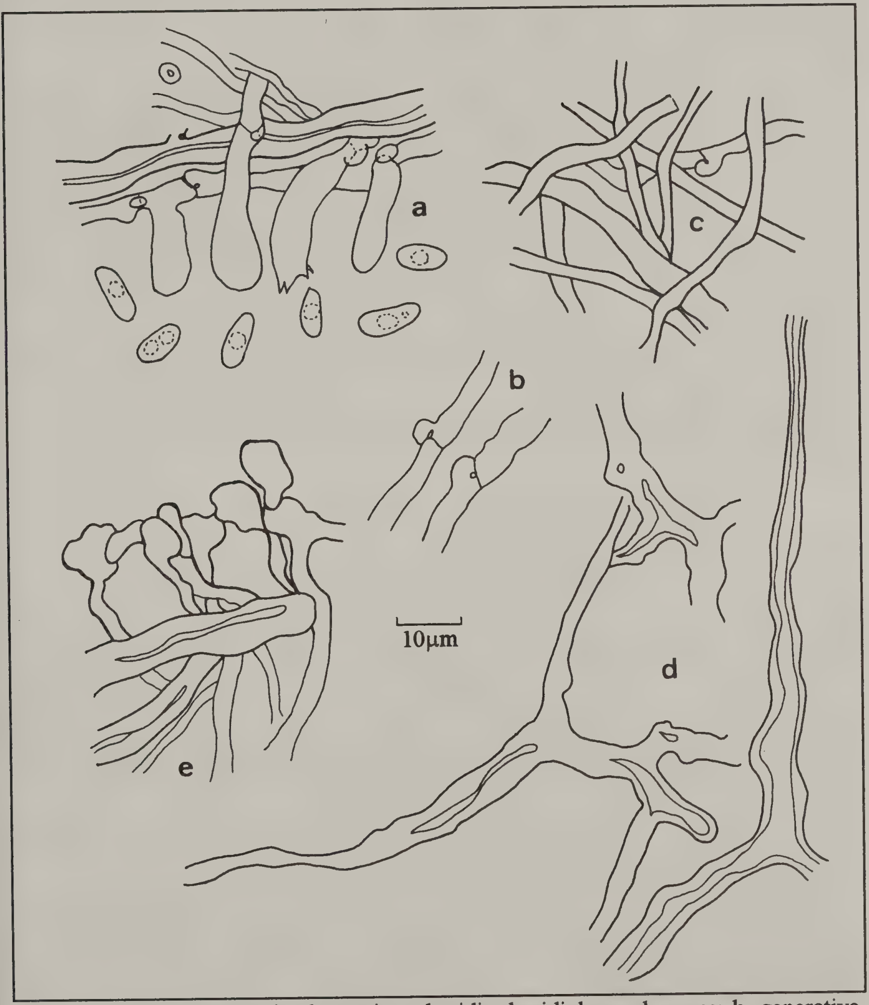

Fig. 7. *Polyporus infernalis*: hymenium: basidia, basidioles and spores; b. generative hyphae; c. context hyphae; d. Bovista type hyphae; e. pilear surface hyphae. (FLOR 11026).

Hyphal system dimitic; generative hyphae clamped, thin-walled, hyaline, 2 - 3 µm diam.; skeletal-binding (Bovista type) hyphae dominanting, thick-walled to solid, yellowish, main axis 4 - 5.5 µm diam. and branches with 2.5 - 3 µm diam., in the trama they are thicker and thinner in the context; stipe cover formed by a palisade of dark hyphae clamped; pilear surface hymeniodermic, with hyphae swollen at the apex, dark brown and hyaline in the context. Basidia claviform, 4-sterigmate, 22 x 6 µm; basidioles 15 - 20 x 5 - 6 µm. Basidiospores cylindric to ellipsoid, thin-walled, hyaline, smooth, (7-) 8 - 10 (-11) x 3 - 4 µm.

Distribution: Australia, Brazil (RO, RS, MG, SC), Guyana and New Zealand.

Material examined: BRAZIL, SC, Ilha de Santa Catarina, Morro da Lagoa da Conceição, Gerber, A. & R. Cabral 472, 30/V/94 (FLOR 11026); ibid, MG, Arraial das Merces, X/1840, ex NY (BAFC 27454).

Remarks: *P. infernalis* is closely related to *P. blanchettianus* Berk. (Reid, 1976), the macroscopic appearence is very similar, but the latter has longer and thicker basidiomes, and larger pores, both have different Bovista-type hyphae. Ryvarden (1977) disagrees with Reid (1976) because he is not certain that the characters that separate these species are genetically fixed or that they are an expression of variability of a same species. Ryvarden & Johansen (1980) used the same argument introduced before by Reid (1976) to separate the species, they did not observe spores in *P. infernalis*. The analysis of BAFC 27454 shows spores similar to FLOR 11026, they are longer than those of *P. blanchettianus*. The pilear surface is hymeniodermic in *P. infernalis*, whereas in *P. blanchettianus* it is anamixodermic. New record for Santa Catarina State. Nunez & Ryvarden (1995) consider that this species is synonymous of *P. dyctiopus* Mont., although they affirm: "... mating tests have shown that this taxon consists of several imcompatibility groups (p. 10, data not published)". *P. dictyopus* (traditional sense) was recorded for Santa Catarina Island by Loguercio-Leite & Wright (1991).

Rigidoporus ulmarius (Sow.: Fr.) Imazeki Fig. 8
Bull. Govt. Exp. Sta. Meguro 57: 119. 1952.

≡ *Polyporus ulmarius* Sow.: Fr., Syst. Mycol. 1: 365. 1821.

Basidiocarp pileate to effused-reflexed, applanate, 11.7 - 19 x 10.5 - 12.5 cm and up to 6 cm thick. Pileus surface glabrous to finely tomentose, azonate, concentrically sulcate, yellow (8/6, 7/6 10YR) to brownish yellow (6/6 10YR). Margin slightly recurved and sterile below. Pore surface very pale brown (7/4 10 YR) to reddish brown (4/4 5YR). Pores circular to angular, 5 - 7 (-8) per mm, dissepiments thin and entire; tubes up to 5 cm deep, concolorous with the pore surface, indistinctly stratified; context up to 5 cm thick, very pale brown (8/3 10YR) to pale yellow (8/4 2.5Y).

Hyphal system monomitic; generative hyphae simple-septate, thin to thick-walled, with rare branches, hyaline to yellowish, 3 - 5.5 µm diam. Cystidia absent, mammiform cystidioles present among basidia, thin-walled, hyaline, 13 - 24 x 5 - 9 µm. Basidia claviform, 4-sterigmate, 14 - 21 x 10 - 11 µm. Basidiospores subglobose to globose, thin to slightly thick-walled, hyaline, smooth, generally with an oil drop, (5.5-) 6 - 7 x (5-) 5.5 - 6 (-6.5) µm.

Distribution: cosmopolitan.

Material examined: BRAZIL, SC, Ilha de Santa Catarina, Morro da Lagoa da Conceição, Gerber, A. & R. Cabral 329, 12/XI/93 (FLOR 10951); ibid, ipse 466, 30/V/94 (11018); ibid, RS, Porto Alegre, Parque Farroupilha, Silveira, R. M. 026, V/87 (ICN 56963); ibid, Cambará do Sul, Itaimbezinho, Silveira, R. M. & R. T. Guerrero 211, 30/IV/89 (ICN 56976).

Remarks: Spores dimensions agree with those of Ryvarden & Johansen (1980) and Silveira & Guerrero (1991) for this species; Gilbertson & Ryvarden (1987) found in North American specimens longer spores (7 - 11 x 6.5 - 10 µm). Spores globose/subglobose, large and mammiform cystidioles between the basidia are good features to identify this species, added to large yellow to brownish yellow coloured basidiomes. New record for Santa Catarina State.

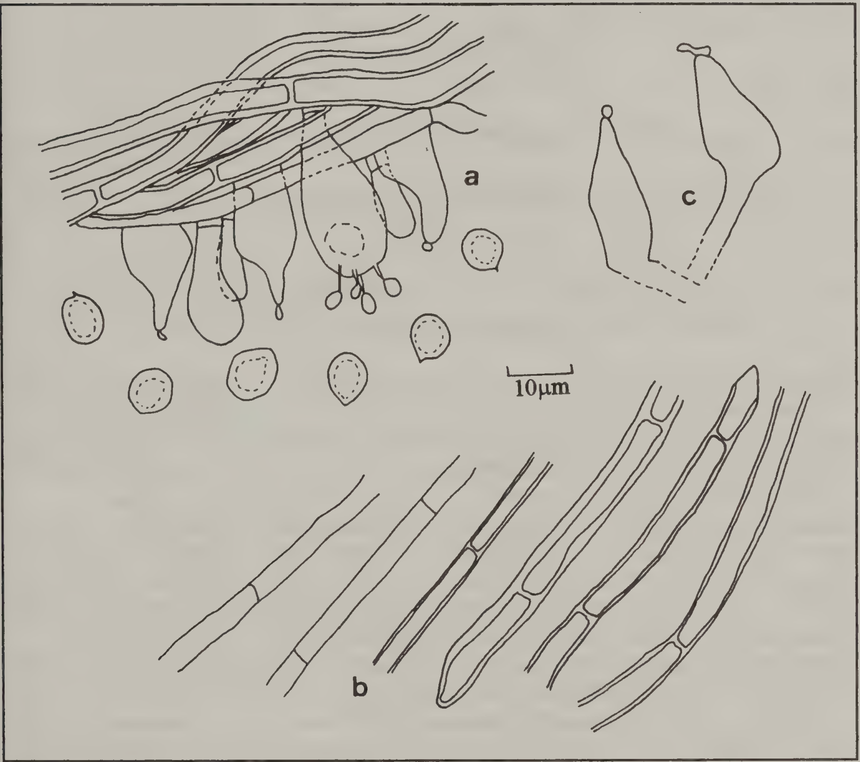

Fig. 8. *Rigidoporus ulmarius*: a. hymenium: basidia, basidioles, spores and cystidioles; b. generative hyphae; c. mammiform cystidioles. (FLOR 10951).

Tyromyces leucomallus (Berk. & Curt.) Murr. Fig. 9
North Am. Flora 9: 36. 1907.

≡ *Polyporus leucomallus* Berk. & Curt., Journ. Linn. Soc. 10: 308. 1868.

Basidiocarp pileate, applanate with umbo, dimidiate to semicircular, 3.9 - 4 x 3.4 cm and up to 7 mm thick. Pileus surface azonate, velvety to tomentose, glabrous when dry, white (8/2 2.5Y) to light gray (7/2 2.5Y). Margin thin and sharp. Pore surface white (8/2 2.5Y) to pale yellow (8/4 2.5Y). Pores circular to angular, 5 - 7 per mm, dissepiments thin and entire; tubes up to 5 mm deep, concolorous with pore surface; context up to 1.5 mm thick, concolorous with pore surface.

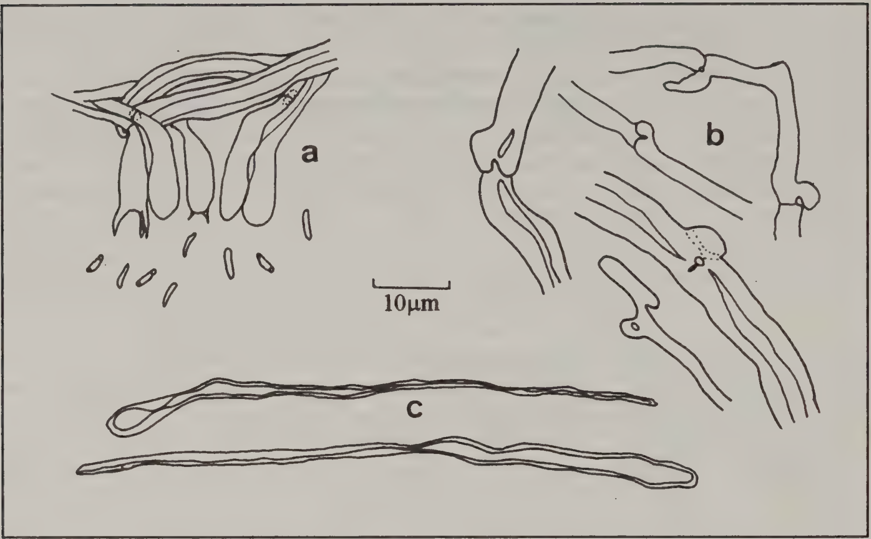

Fig. 9. *Tyromyces leucomallus*: a. hymenium: basidia, basidioles and spores; b. generative hyphae; c. "gloeopleurous hyphae". (FLOR 11024).

Hyphal system monomitic; generative hyphae clamped, thin to thick-walled, the walls swell and gelatinize in KOH, hyaline to pale yellow, 1.5 - 5 µm diam. in the trama, up to 7 µm in the context; yellowish hyphae present in the trama (gloeopleurous hyphae?), 2 - 5.5 µm. Basidia claviform, 4-sterigmate, 10 - 13 x 4 - 5 µm. Basidiospores allantoid, thin-walled, hyaline, smooth, 3.5 - 4.5 x 0.75 - 1 µm.
Distribution: Brazil (PR, SC, RS), Cuba, United States, Jamaica and Nepal.
Material examined: BRAZIL, SC, Ilha de Santa Catarina, Morro da Lagoa da Conceição, Gerber, A., M. A. Halmenschlager & R. Cabral 414, 29/III/94 (FLOR 11024); ibid, ipse 506, 28/VI/94 (FLOR 11028); ibid, PR, Morretes, Parque Estadual Marumbi, Rio do Nunes, Meijer, A. 968, 06/XII/87 (BAFC 31326).
Remarks: Spores measurements coincide with those given by Gilbertson & Ryvarden (1987) (3.5 - 4.5 x 1 µm), but differ from those given by Lowe (1975) for the holotype (4 - 5.5 x 1 - 1.5 µm); however, Gilbertson & Ryvarden (1987) commenting on this species state that their measurements of the holotype spores disagree with those given by Lowe (1975), being smaller. The generative hyphae gelatinizing in KOH and the allantoid spores are good characteristics to recognize the species.

CONCLUSIONS

Mapping of the fungi of the Santa Catarina Island may only undertaken by intensive collecting in a chosen and defined area (Lagoa da Conceição Hill) during defined periods (in the present case 13 months) for a better knowledge of this mycota. Through this method 9 species were added to the known mycota, namely 67 (Loguercio-Leite & Wright, 1991). The only cosmopolitan species found was *Rigidoporus ulmarius*. All species were found on angiosperms. Lack of on adequate number of fungal taxonomists, and the immense territory, make mapping of the Brazilian mycota a formidable endeavour compared to the quadrat method used in Europe.

ACKNOWLEGMENTS

We are grateful to Dr. James Ginns (Ottawa, Canada) and Dr. Jorge E. Wright (Buenos Aires, Argentina) for the exhaustive review and invaluable criticism.

LITERATURE CITATED

AHMAD, S. 1972. Basidiomycetes of West Pakistan. Monogr, **Biol. Soc. Pakistan 6**: 1 - 141

CARUSO, M. M. L. 1990. **O desmatamento da Ilha de Santa Catarina de 1500 aos dias atuais**. 2° ed. rev., Ed. da UFSC, Florianópolis.

CABRERA, A. L. & WILLINK, A. 1973. **Biogeografia de América Latina**. Prog. Reg. Des. Cient., Dept° As. Cient. OEA.

CUNNINGHAM, G. 1965. Polyporaceae of New Zealand. **N. Z. Dep. Sci. Ind. Res. Bul. 164.**

GERBER, A. L. 1994.**Levantamento dos fungos xilófilos poróides (Aphyllophorales) no Morro da Lagoa da Conceição, Ilha de Santa Catarina, SC.** Trabalho para obtenção do grau de Bacharel em Ciências Biológicas, UFSC.

GILBERTSON, R. L. & RYVARDEN, L. 1986/87. **North America polypores**, vols. 1 and 2. Fungiflora, Oslo.

GINNS, J. 1980. The genus *Flaviporus* Murr. (Polyporaceae). **Canad. J. Bot. 58**: 1578 - 1590.

GUGLIOTTA, A. M. & M. CAPELARI. 1995. Polyporaceae from Ilha do Cardoso, SP, Brazil. **Mycotaxon 56**: 107 - 113.

HOLMGREN, P. K. & KEUKEN, W. 1974. The Herbaria of the World in **STAFLEU, F. A. Index Herbariorum**, Pt. 1. Utrcht, Int. Bureau for Plant Taxonomy and Nomenclature. 6 ed.

JESUS, M. A. 1996. Contribution to the knowledge of wood-rotting fungi in Brazil. II. Checklist of fungi from Maracá Island, Rondônia State. **Mycotaxon 57**: 323 - 328.

LARSEN, M. J. & COBB-POULLE, L. A. 1990. **The genus *Phellinus* - a survey of the world taxa**. Synopsis fungorum 3. Fungiflora, Oslo.

LOGUERCIO-LEITE, C. & WRIGHT, J. E. 1991. Contribution to a biogeographical study of the austro-american xylophilous polypores (Aphyllophorales) from Santa Catarina Island, SC., Brazil. **Mycotaxon 41(1)**: 161 - 166.

LÒWE, J. L. 1966. Polyporaceae of North America. The genus *Poria*. **State Univ. N. Y. Coll. For. Tech. Publ. 90**: 1 - 183.

---------------- 1975. Polyporaceae of North America. The genus *Tyromyces*. **Mycotaxon 2(1)**: 1 -82.

MUNSELL, L. 1975. Munsell soil color charts. **U. S. Dep. Agric. Handb. 18** - Soil Survey Manual.

NUNEZ, M. & RYVARDEN, L. 1995. ***Polyporus* (Basidiomycotina) and related genera**. Synopsis Fungorum 10. Fungiflora, Oslo.

RACHJENBERG, M. & WRIGHT, J. E. 1987. Type studies of Corticiaceae and Polyporaceae (Aphyllophorales) described by C. Spegazzini. **Mycologia 79(2)**: 246 - 264.

REID, D. A. 1955. **Aphyllophorales and Gasteromycetes. In results of the Norwegian scientific expedition to Tristan de Cunha. 1937 - 1938**. N° 37. Det Norske Videnskaps-Akademi, Oslo. pp 12 - 14.

--------------- 1976. Notes on polypores 2. **Mem. New York Bot. Garden 28(1)**: 179 - 198.

RYVARDEN, L. 1977. Type studies in the Polyporaceae 10. Species described by J. M. Berkeley either alone or with other authors, from 1844 to 1855. **Norw. J. Bot. 24**: 213 - 230.

---------------- & I. JOHANSEN. 1980. **A preliminary polypore flora of East Africa**. Fungiflora, Oslo.

SILVEIRA, R. M. B. & R. T. GUERRERO. 1991. Aphyllophorales poliporóides (Basidiomycetes) no Parque Nacional de Aparados da Serra, Rio Grande do Sul. **B. Inst. Bioc. 48**: 1 - 127.

ZHAO, J. D. 1989. The Ganodermataceae in China. **Bibliotheca Mycologica 132**: 1 - 175.

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MEXICAN DIDYMIACEAE (MYXOMYCETES, ORDER PHYSARALES): THREE NEW RECORDS AND COMMENTS ON MUCILAGO CRUSTACEA

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ABSTRACT

Diderma floriforme, D. miniatum and *Didymium serpula* are recorded for the first time for Mexico, the last one being previously unknown from the Neotropics. *Diderma miniatum* was previously known only from the type collection from a cloud forest in Ecuador and from Venezuela. Additional comments are given for *Mucilago crustacea*.

RESUMEN

Diderma floriforme, D. miniatum y *Didymium serpula* son registrados por primera vez para México, la última no conocida hasta ahora para la zona neotropical. *Diderma miniatum* sólo se conocía de la colección tipo procedente de un bosque mesófilo en Ecuador y de Venezuela. Además, se incluyen algunas observaciones sobre *Mucilago crustacea.*

INTRODUCTION

The Didymiaceae is one of the most conspicuous and best known families of Myxomycetes in Mexico, representing approximately 15 % of the myxomycete species which have been recorded in this country. Thirty taxa from this family have been found in Mexico. *Diderma* and *Didymium*, each with twelve species are the most frequently cited genera in the literature (Braun & Keller, 1976; López *et al.*, 1979, 1981a, 1981b; Gómez-Sánchez & Castillo, 1981; Villarreal, 1983, 1990; Guzmán & Villarreal, 1984; Pérez-Moreno & Villarreal, 1988; Hernández-Cuevas *et al.*, 1991).

Nevertheless, the knowledge on Mexican Didymiaceae is far from complete due to the lack of records from most of the Mexican territory. In this paper we describe and discuss three taxa of Didymiaceae not previously found in our country; one of them was only known from the type collection in Ecuador and from Venezuela. Furthermore, some observations of *Mucilago crustacea* are discussed.

MATERIALS AND METHODS

Identifications were made using the keys of Martin & Alexopoulos (1969), Farr (1976) and Nannenga-Bremekamp (1991). Color determinations were made using Munsell (Ml) (U.S. Department of Agriculture, 1975) or Methuen (Mn) (Kornerup & Wanscher, 1978) color charts. At least fifty spores of each specimen were measured.

All the specimens are deposited at the Mycological Collection of the TLXM Herbarium (Centro de Investigación en Ciencias Biológicas, Universidad Autónoma de Tlaxcala) with some duplicates at the Mrs. N.E. Nannenga-Bremekamp's, Mrs. F. Meyer's and D.W. Mitchell's private collections.

DESCRIPTION OF THE SPECIES

Diderma floriforme (Bull.) Pers.
Figs. 1A-D and 2A-B.

Sporangia stalked, gregarious (fig. 1A), 2.3 - 2.5 mm in total height sporangium proper, subglobose, 1.0 - 1.1 mm long and 1.0 mm wide; peridium double, the outer layer cartilaginous, nearly white (Ml: 5YR8/1) to light reddish brown (Ml: 5YR6/3), firmly adhering to the pinkish white (Ml: 5Y8/2) inner calcareous layer;

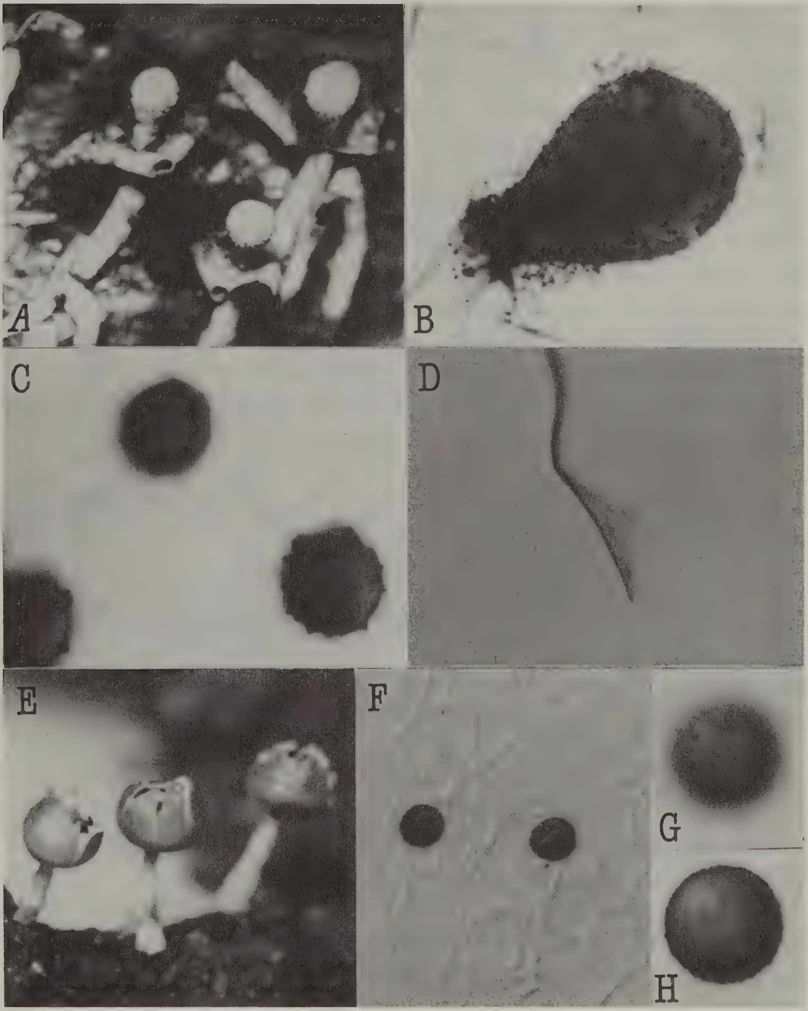

Fig. 1A-D. ***Diderma floriforme*** (Estrada-Torres # 2396). A. Sporangia (X 13.2); B. Columellae (X 44); C. Spores (X 1100); D. Membranous expanded tip (Nomarski's Interference Contrast: NIC X 1100). **E-H.** ***D. miniatum*** (Estrada-Torres # 3613). E. Sporangia (X 13.2); F. Capillitium (NIC X 440); G. Spore in surface view (NIC X 1100); H. Spore in optical section (NIC X 1100).

dehiscence stellate with the lobes reflexed; columellae clavate (fig. 1B), up to 0.6 mm long and 0.3 - 0.4 mm in diameter, calcareous, rugose, pink (Ml: 5YR7/3) to yellowish red (Ml: 5YR5/4) at the base and pale orange (Mn: 5A3) to pink (Ml: 7.5YR8/4) at the apex; stalk long, stout, 1.3 - 1.5 mm long, 0.1 - 0.3 mm in diameter, calcareous, yellowish red (Ml: 5YR5/8) to light orange (Mn: 5A4) at the apex; hypothallus conspicuous, membranous, shining; capillitium abundant, sparsely branched, dark reddish brown (Ml: 5YR3/2) by transmitted light, with some membranous, hyaline and expanded tips (figs. 1D and 2A) with a few subglobose dark swellings along the threads; spores black (Ml: 2.5YR2.5/0) in mass, dark reddish brown (Ml: 2.5YR3/4) by transmitted light, slightly paler in one hemisphere, ornamented with prominent and scattered spines (figs. 1C and 2B), globose, (9.0-) 10.0 (-12.0) μm in diameter.

HABITAT: On rotten bark, in a cloud forest with *Liquidambar* and *Quercus*.

SPECIMEN EXAMINED: HIDALGO STATE, Tlalchinol Municipality, "Fosas de Tlalchinol": 29/10/88, legit **Estrada-Torres # 2396**. Altitude 2 460 m. The weather is wet temperate (Cf) according to Koppen's climatic system modified by García (1982). ADDITIONAL SPECIMEN EXAMINED: U.S.A., WEST VIRGINIA, Randolph Co., 28/9/90, legit **Stephenson # 7408**.

GEOGRAPHICAL DISTRIBUTION: *Diderma floriforme* has been recorded from Guadeloupe Island? (Farr, 1976), United States (Martin & Alexopoulos, 1969; Mitchel *et al.*, 1980; Eliasson *et al.*, 1988; Stephenson, 1988), British Isles (Ing, 1982; Ing & McHugh, 1988), the territory of the ex Soviet Union (Novogilov, 1985), China (Yu & Hui-Zhong, 1989), Spain (Illana *et al.*, 1990) and Netherlands (Nannenga-Bremekamp, 1991).

DISCUSSION: Martin & Alexopoulos (1969) pointed out that *Diderma floriforme* is easily recognized by its stellate dehiscence, the prominent columellae and the blunt and scattered verrucae on the spores. In the Mexican specimen, the spores have a prominent spiny ornamentation, with the same arrangement which was noted by Martin & Alexopoulos (1969). Nevertheless, Nannenga-Bremekamp (1991) reported spores with large, dark and conical spines, similar to those found in our collection. On the other hand, the membranous and hyaline expansions in the tips of the

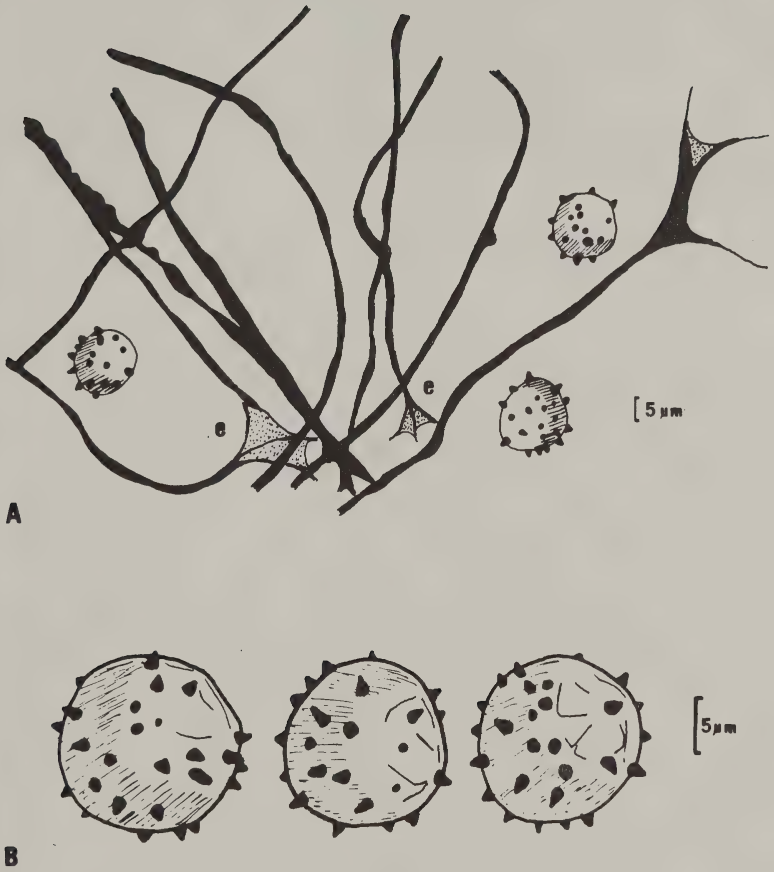

Fig. 2A-B. ***Diderma floriforme*** (Estrada-Torres #2369). A. Capillitium with membranous expanded tips (e) and spores; B. Spiny ornamentation and darker hemisphere of spores.

capillitium were not mentioned by Martin & Alexopoulos (1969) nor by Nannenga-Bremekamp (1991), but they were reported by Farr (1976).

The distribution data of *Diderma floriforme* indicate that this species is more abundant in temperate regions of the Northern Hemisphere (Martin & Alexopoulos, 1969). Farr (1976) included this species in her monograph of the Neotropics based on one report from Guadeloupe Island (specimen **Duss 489**), but she pointed out that if that specimen still exists it would need to be re-examined to confirm its identity.

Diderma miniatum Nann.-Brem.
Figs. 1E-H and 3A-B.

Sporangia stalked, gregarious (fig. 1E), 1.0 - 1.5 mm long, subglobose to hemispheric, sometimes slightly depressed at the center and umbilicate below, 0.6 - 1.1 mm in diameter; peridium triple, the outer layer smooth, subcartilaginous, shining, orange red (Mn: 8AB8) to reddish orange (Mn: 7A7), firmly adhering to the middle layer, which is calcareous, smooth to slightly granulose, nearly white, pale orange yellow (Mn: 4A8) to pale yellow (Mn: 4A3); inner layer membranous, frequently firmly adhering to the calcareous layer, and then inconspicuous, but in mature specimens sometimes distant, translucent, iridescent and early evanescent; dehiscence of the two outer layers irregularly areolate above and regular below, divided into petal-like lobes which sometimes become reflexed at the base, but most frequently persist like a cup; columellae globose, stalked, reaching about one-half of the height of sporangium, orange red (Mn: 8A7) to light yellow (Mn: 4A5) at the base and pedicellum; stalk stout, short, up to 0.6 mm long, calcareous, cylindrical, but sometimes attenuate at the apex, wall pale reddish orange (Mn: 7A8) at the apex, and reddish yellow (Mn: 7A4) to light yellow (Mn: 4A3.5) at the base; hypothallus membranous, inconspicuous, shining; capillitium abundant, pale, strongly reticulate (figs. 1F, 3A), with the threads fused to the membranous inner peridial layer by funnel-shaped tips, the capillitial threads slender, pale yellow (Mn: 3A2) to hyaline by transmitted light, 1.0 - 2.0 μm in diameter; spores black in the mass, purplish brown by transmitted light, coarsely verrucose on one hemisphere

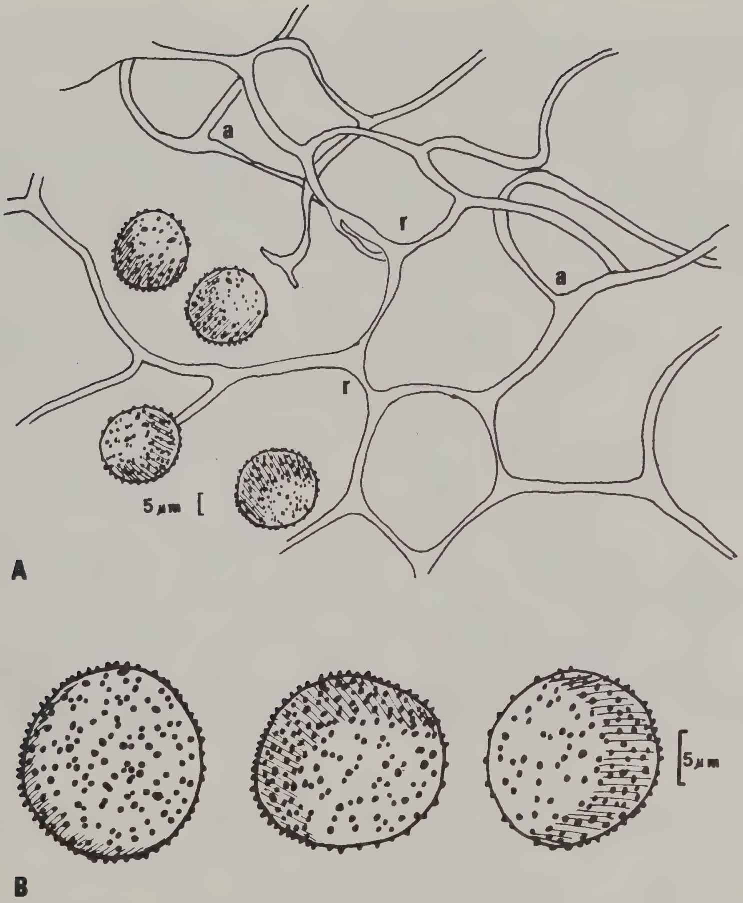

Fig. 3A-B. ***Diderma miniatum*** (Hernández-Cuevas # 2255). A. Capillitium with rounded (r) and angular (a) axils and spores; B. Spores with a darker hemisphere.

and paler and with scattered warts on the other (figs. 1G-H and 3B), (10.0-) 11.0 -12.0 (-13.0) μm in diameter. Phaneroplasmodium bright orange red (Mn: 8A8).

HABITAT: On dead leaves and twigs of *Quercus* and *Comarostaphyllis polifolia* in a *Pinus-Quercus* forest.

SPECIMENS EXAMINED: TLAXCALA STATE, Totolac Municipality, Tepeticpac Hill: 26/9/90, legit **Estrada-Torres # 3123**; 10/10/90, legit **Estrada-Torres # 3144**; 2/9/92, legit **Estrada-Torres # 3398**; 30/9/92, legit **Hernández-Cuevas # 2255**; 23/10/92, legit **Hernández-Cuevas # 2283**; 12/10/94, legit **Estrada-Torres # 3613**. Altitude 2 500 m. The weather here is subwet temperate with a rainy season in summer [C (w_2) (w)] (INEGI, 1981).

GEOGRAPHICAL DISTRIBUTION: *Diderma miniatum* was described from Ecuador (Nannenga-Bremekamp (1989). It has since been collected in Venezuela by Dr. S.L. Stephenson (Nannenga-Bremekamp, personal communication). Mexico is the third country from which it is recorded.

DISCUSSION: Nannenga-Bremekamp (1989) pointed out that *Diderma miniatum* has a colorless inner peridium, a conical columellae, a capillitium with rounded axils and spores sparsely covered with dark, minute warts. In contrast all the Mexican specimens have an iridescent inner peridium, a globose to subglobose stalked columella, a capillitium with rounded to angular axils and spores more ornamented and darkely colored on one hemisphere. However, these characteristics could be a product of environmental variability and we think that these are insufficient to separate this material into a different taxon.

Diderma lucidum has orange or vermillion sporangia and may look like *D. miniatum*, but it can readily be segregated by its dark stalks and capillitium and by its double peridium, its irregular dehiscence and spores which are uniformly colored, evenly ornamented and larger (13 - 15 μm).

Didymium serpula Fries
Figs. 4A-C and 5A-B.

Plasmodiocarps simple or slightly branched (fig. 4A),

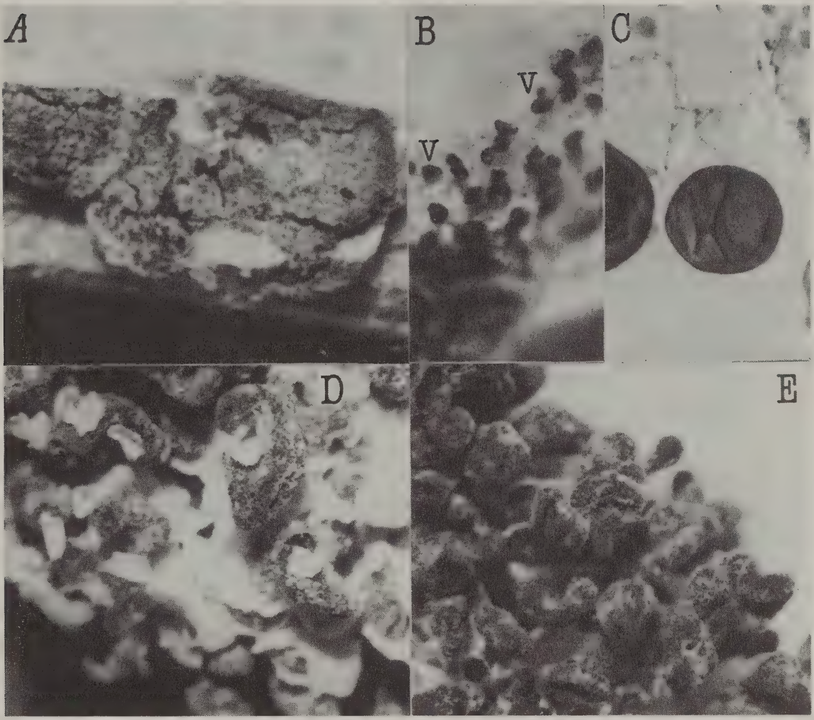

Fig. 4A-C. ***Didymium serpula*** (Rodríguez-Palma # 1486). A. Plasmodiocarps (X 8.8); B. Vesicles (v) between capillitial threads (X 44); C. Vesicles penetrated by capillitial threads (NIC X 220); **D-E.** ***Mucilago crustacea*** (Estrada-Torres # 3623); D. Fructification covered with a peridial calcium carbonate layer (X 8.8); E. 3-dimensional network of sporangia (X 8.8).

sometimes annulate or pulvinate, whitish due to the remains of calcium carbonate, 3 - 10 mm in length and 3 - 6 mm in width; peridium simple, membranous, slightly iridescent, shining, golden yellow (Mn: 5B7), covered with a rather sparse layer of calcareous crystals about as larger or somewhat than the spores (fig. 5A); dehiscence irregular; capillitium abundant, united in a reticulum with rigid threads, hyaline to yellowish by transmitted light, associated with numerous and large subglobose dark brown vesicles (fig. 4B) (30.0-) 42.0 (-74.0) μm in diameter, invaginated and then penetrated by the capillitial threads (figs. 4B-C and 5A), ; hypothallus cartilaginous, prominent, grayish yellow (Mn: 4B6), yellowish white (Mn: 4A2) to pale yellow (Mn: 4A3) due to calcium carbonate; spores and vesicles dark brown (Ml: 10YR3/3) in the mass, strong brown (Ml: 7.5YR5/6) by transmitted light, densely warted, spores globose (fig. 5B), (9.5-) 10.0 (-11.0) μm in diameter.

HABITAT: On stems of *Senecio*, in an *Abies-Pinus* forest.

SPECIMENS EXAMINED: TLAXCALA STATE, Ixtenco Municipality, East Slope of the Malintzi Volcano: 28/9/88, legit **Hernández-Cuevas # 794**, Altitude 3 100 m; 2/2/90, legit **Rodríguez-Palma # 1486**, Altitude 3 450 m; 12/9/95, legit **Hernández-Cuevas # 2298**, Altitude 3 300 m. The weather is semicold to cold [(E) (w_2) w] (INEGI, 1981).

GEOGRAPHICAL DISTRIBUTION: This taxon has been recorded from Sweden (Santesson, 1964), United States, Pakistan (Martin & Alexopoulos, 1969), British Isles (Ing, 1982), Bielorusia (Moroz & Novozhilov, 1988), Taiwan (Yu & Hui-Zhong, 1989), Spain (Illana *et al.*, 1990; Moreno *et al.*, 1991) and the Netherlands (Nannenga-Bremekamp, 1991).

DISCUSSION: This species can be easily recognized by its plasmodiocarpous habit and its large vesicles in the capillitium. Martin & Alexopoulos (1969) considered *Didymium serpula* widely distributed in the temperate zones of the Northern Hemisphere, however, it has recently been recorded from subtropical areas (Yu & Hui-Zhong, 1989). The Mexican specimen is the first record from the Neotropics and the Malintzi Volcano is the southernmost known locality of the species.

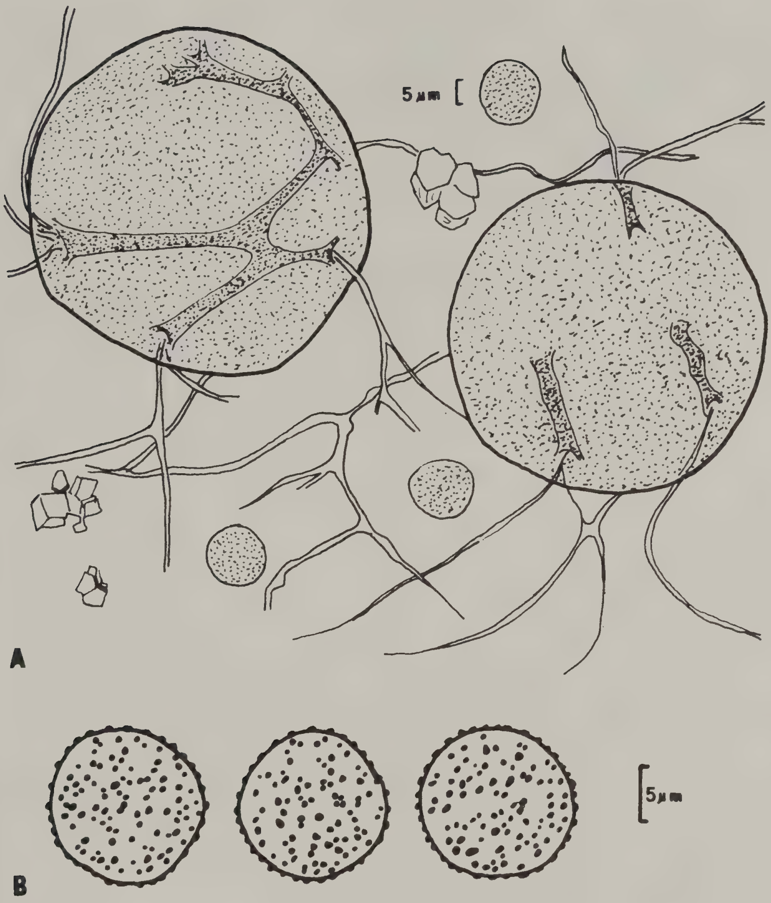

Fig. 5A-B. ***Didymium serpula*** (Rodríguez-Palma # 1486). A. Vesicles penetrated by capillitial threads (c), polygonal calcium carbonate crystals and spores; B. Spores.

Mucilago crustacea Wiggers
Figs. 4D-E and 6A-B.

Aethalium formed by very crowded sporangia or plasmodiocarps sessile, subsessile and sometimes pendents on slender stalks, branched, anastomosing freely and forming a complex three dimensional network (figs. 4D-E), pure white (Mn: 1A1), 18.4 - 34.8 mm long and 17 - 54 mm wide, rarely with some simple sporangia scattered among the plasmodiocarps; sporangia terete or slightly flattened laterally, 0.3 - 0.4 mm in diameter, 0.6 - 3.5 mm long (fig. 4E); peridium double, the outer layer calcareous, forming a developed cortex (fig. 4D), pure white (Mn: 1A1), but sometimes distant, fragile, lustrous, egg-shell-like, crystalline, covering all the fruiting bodies (fig. 4E), when this peridial layer is shell-like it may penetrate between adjacent bodies, but never loose its continuity; the inner layer is membranous, translucent, slightly iridescent, sprinkled with calcium carbonate, reddish white (Mn: 10A2), very pale brown (Ml: 10YR8/4) by transmitted light; columellae absent; stalk when present, slender, weak, repent, yellowish, like an extension of the hypotallus; hypotallus conspicuous, spongy or coriaceum, shining, whitish to pale yellow (Mn: 4A3), frequently densely covered by calcium carbonate; capillitium abundant, firmly attached to inner peridium, mixed with the pseudocapillitium which is produced by portions of sporangial walls, very pale brown (Ml: 10YR7/4) by transmitted light, colorless at the junctions with the peridium, densely branched and anastomosed forming a closed network (fig. 6A), 1.5 - 2.0 (-4.0) μm in diameter, often with globose to elliptic nodes, dark yellowish brown (Ml: 10YR4/4), (2.0-) 3.0 - 4.0 (5.0) μm wide; spores black in the mass, violet brown (Mn: 10E8) by transmitted light, closely warted (fig. 6B), globose, (11-) 12 - 14 (-15) μm in diameter. Plasmodium watery white.

HABITAT: On *Juniperus* debris, soil, and living and dead grasses and herbaceous plants in *Juniperus-Quercus*, *Quercus* or *Pinus-Quercus* forests and on dead twigs of *Abies religiosa* and dead and living *Baccharis* stems, in an *Abies-Pinus* forest.

SPECIMENS EXAMINED: TLAXCALA STATE, Ixtacuixtla Municipality: Federal Road Mexico-Veracruz, 10.5 Km section Texmelucan-Tlaxcala, Altitude 2 300 m: 19/7/89, legit **Estrada-Torres # 2543a**; 6/9/89, legit **Rodríguez-Palma # 1196**; 27/9/92, legit **Hernández-Cuevas # 2215**; 17/8/92, legit **Hernández-Cuevas # 2210**;

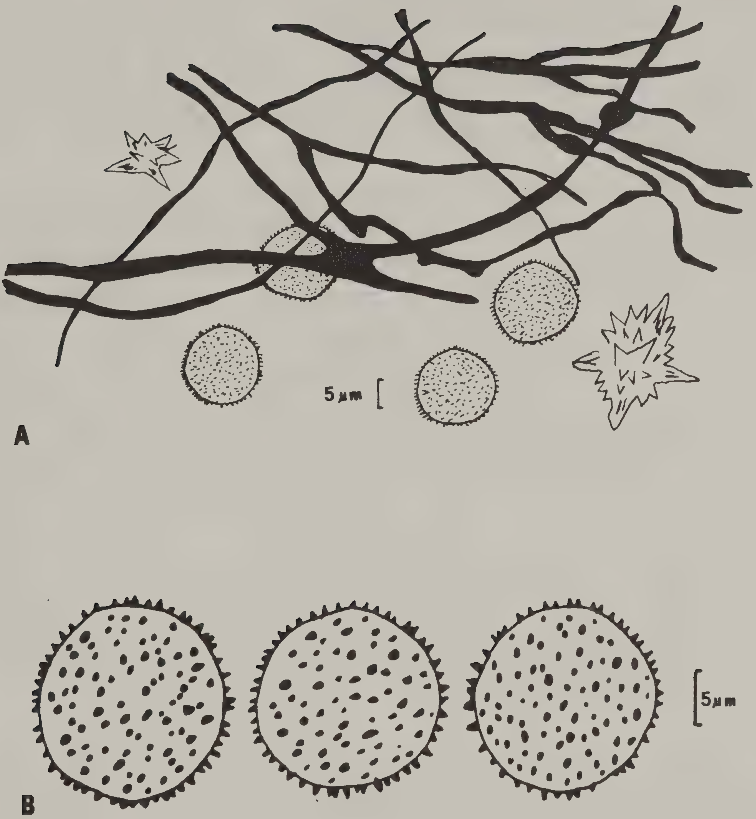

Fig. 6A-B. ***Mucilago crustacea*** (Hernández-Cuevas # 1164). A. Capillitium, spores and stellate calcium carbonate crystals; B. Spores.

27/10/92, legit **Hernández-Cuevas # 2280**. Totolac Municipality: Tepeticpac Hill: 3/8/90, legit **Rodríguez-Palma # 1824, # 1828**: 29/8/90, legit **Hernández-Cuevas # 1913**; 26/9/90, legit **Estrada-Torres # 3127**; 10/10/90, legit **Estrada-Torres # 3133, # 3138**; 26/7/91, legit **Hernández-Cuevas # 2066**. Tizatlán Hill: 12/9/90, legit **Hernández-Cuevas # 1947**. Panotla Municipality: Temezontla, ravine "La Cuesta", 1 Km from Huiloapan: 16/9/92, legit **Hernández-Cuevas # 2250**. Ixtenco Municipality, East Slope of the Malintzi Volcano, Altitude 3 200 - 3 300 m: 25/7/90, legit **Hernández-Cuevas # 1164**; 25/1/95, legit **Estrada-Torres # 3623** . The weather of Ixtacuixtla, Tepeticpac and Temezontla are subwet temperate with rainy season in summer [C(w_2) (w)] (INEGI, 1981).

GEOGRAPHICAL DISTRIBUTION: According to Martin & Alexopoulos (1969) *Mucilago crustacea* is an extremely common and widely distributed species. It has been recorded from the United States (Gilbert, 1927; Cooke, 1951; Evenson, 1961; Alexopoulos & Henney, 1971; Kowalski, 1973; Mitchel *et al*., 1980; Eliasson *et al*., 1988), Sweden (Santesson, 1964), Israel (Ramon, 1968), Angola (Almeida, 1973), Finland (Härkonen, 1979), Austria (Schinner, 1982), Poland (Stojanowska, 1983), Portugal (Almeida, 1985; Ladó & Pando, 1988), Bielorusia (Moroz & Novozhilov, 1988), British Isles (Ing & McHugh, 1988), China (Yu & Hui-Zhong, 1989), Canada (Richardson & Currah, 1990), New Zealand (Mitchell, 1992), the Netherlands (Nannenga-Bremekamp, 1991) and Spain (Ladó, 1993). In Mexico, this species has been recorded from the State of Mexico (Braun & Keller, 1976), Nuevo Leon (Gómez-Sánchez & Castillo, 1981), Veracruz (López *et al*., 1981a), Queretaro and Zacatecas (Villarreal, 1990).

DISCUSSION: *Mucilago* is monotypic and is the only genus in the Didymiaceae which forms aethalia. According to Martin & Alexopoulos (1969) *M. crustacea* is an extremely common and widely distributed species, variable in spore size, cortex consistency and calcium carbonate crystal size. Nannenga-Bremekamp (1991) recognized two varieties of this species, which are distinguished mainly by their growth habits: var. *crustacea*, showing a group of individualized plasmodiocarps forming an intricate mass covered by a common calcareous shell-like peridium and cortex composed of empty peridium which is often early fugaceous, and var. *solida* represented by a clearly defined aethalium with a defined and developed cortex. If these varieties of *M. crustacea* are recognized, then we have both of them from Tlaxcala, var. *crustacea* like forms were found only twice in cold areas at high elevations in *Abies-Pinus* forest from Malintzi Volcano, and var. *solida* like forms were found most frequently in forest with calcareous soils. Martin & Alexopoulos (1969) argued that the transition from one variety to another is complete, and suggested expanding the definition of this species. Our specimens could be only different expresions of the same species in distinct environments. Nevertheless, the real taxonomic status of these varieties will not be elucidated until more collections are available and experimental work is completed.

Due to its growth habit, the less crowded forms of *Mucilago crustacea* resemble *Erionema*, but the latter genus is easily distinguished from *Mucilago* by the nature of the calcium carbonate which is granular in *Erionema* and crystalline in *Mucilago*.

AKNOWLEDGEMENTS

We would like to thank Mrs. Nannenga-Bremekamp, Mr. D.W. Mitchell and Dr. H.W. Keller for their revision and comments on the manuscript, and to Mrs. Nannenga-Bremekamp for confirmation of the *Diderma miniatum* identification.

LITERATURE CITED

Alexopoulos, M. & W. Henney, 1971. Myxomycetes from Texas. II. Additions and corrections. Southwest. Nat. 16(1):43-50.

Almeida, M.G., 1973. Contribucao para o conhecimento dos Myxomycetes de Angola. Bol. Soc. Brot. 47:227-297.

Almeida, M.G., 1985. Contribucao para o estudo dos Myxomycetes de Portugal. VII. Portug. Acta Biol. (B) 14:5-10.

Braun, K.L. & H.W. Keller, 1976. Myxomycetes of Mexico I. Mycotaxon 3(2):297-317.

Cooke, W.D., 1951. Some Myxomycetes from South Central Washington. Northwest Sci. 25:171-175.

Eliasson, U., H.W. Keller & J.A. Hutchinson, 1988. Myxomycetes from Arkansas. Mycotaxon 32:375-398.

Evenson, A., 1962. A preliminary report of the Myxomycetes of Southern Arizona. Mycologia 53:137-144.

Farr, M.L., 1976. The Myxomycetes. In: The New York Botanical Garden (ed.). Flora Neotropica 16. New York.

Gilbert, R.A., 1927. Notes on Myxomycetes from Easthern Massachusetts. Rhodora 29:165-173.

Gómez-Sánchez, A. & J. Castillo, 1981. Estudio sobre los Myxomycetes del estado de Nuevo León. Bol. Soc. Mex. Mic. 15:199-223.

Guzmán, G. & L. Villarreal, 1984. Estudio sobre los hongos, líquenes y mixomicetos del Cofre de Perote, Veracruz. I. Introducción a la micoflora de la región. Bol. Soc. Mex. Mic. 19:107-124.

Harkönen, M., 1979. A checklist of Finnish Myxomycetes. Karst. 27:1-7.

Hernández-Cuevas, L., G. Galindo-Flores, M.M. Rodríguez-Palma & A. Estrada-Torres, 1991. New records of Myxomycetes from Mexico. Mycotaxon 42:17-27.

INEGI, 1981. Síntesis Geográfica de Tlaxcala. S.P.P., México, D.F.

Ing, B., 1982. A revised census catalogue of British Myxomycetes. Part 2. Bull. Brit. Mycol. Soc. 16(11):26-36.

Ing, B. & R. McHugh, 1988. A revision of Irish Myxomycetes. Proc. Royal Irish Acad. B 88(7):99-117.

Illana, C., M. Heykoop & G. Moreno, 1990. Contribution to the study of the myxomycete in Spain III. Catalogue of the Myxomycetes of Spain. Mycotaxon 38:37-69.

Kornerup, A. & J.H. Wanscher, 1984. Methuen handbook of color. Wanscher, Sussex.

Kowalski, D.T., 1973. New records of Myxomycetes from California. V. Madroño 22:97-100.

Ladó, C., 1993. Cuadernos de Trabajo de Flora Micológica Ibérica. 7. FARESO, Madrid.

Ladó, C. & F. Pando, 1989. La colección de Myxomycetes preparada por C. Torrend para el Colegio San Fiel Portugal. Anales Jard. Bot. Madrid 46(1):173-180.

López, A., A. Sosa & L. Villarreal, 1979. Estudios sobre los Myxomycetes del estado de Veracruz I. Bol. Soc. Mex. Mic. 13:127-144.

López, A., A. Sosa & L. Villarreal, 1981a. Estudios sobre los Myxomycetes del estado de Veracruz II. Biotica 6(1):43-56.

López, A., A. Sosa & L. Villarreal, 1981b. Estudios sobre los Myxomycetes del estado de Veracruz III. Bol. Soc. Mex. Mic. 16:77-93.

Martin, C.W. & C.J. Alexopoulos. The Myxomycetes. University of Iowa Press, Iowa.

Mitchel, D.H., S.W. Chapman & M.L. Farr, 1980. Notes on Colorado fungi IV: Myxomycetes. Mycotaxon 1(2):299-349.

Mitchell, D.H., 1992. The Myxomycota of New Zealand and its island territories. Nova Hedw. 55(1-2):231-256.

Moreno, G., C. Illana & M. Heykoop, 1991. Contribution to the study of the Myxomycetes in Spain. IV. Mycotaxon 41(1):113-125.

Moroz, E.C. & J.K. Novozhilov, 1988. Conspectus Myxomycetum RSS Belorussiae. Nov. Syst. Plant non. Vasc. 25:92-97.

Nannenga-Bremekamp, N.E., 1989. Notes on myxomycetes XXIII. Seven new species of Myxomycetes. Procc. K. Ned. Akad. Wet. Ser. C 92(4):505-515.

Nannenga-Bremekamp, N.E., 1991. A guide to temperate Myxomycetes. Biopress Limited Bristol, Bristol.

Novogilov, J.K., 1985. Conspectus Myxomycetum in URSS vigentum. Nov. Syst. Plant non Vasc. 22:136-146.

Pérez-Moreno, J. & L. Villarreal, 1988. Los hongos y Myxomycetes del estado de Chiapas, México. estado actual de conocimiento y nuevos registros. Mic. Neotrop. Aplic. 1:97-133.

Rsmon, E., 1968. Myxomycetes of Israel. Israel J. Bot. 17:207-211.

Richardson, K.A. & R.S. Currah, 1990. Myxomycetes of Alberta. Mycotaxon 27:369-378.

Santesson, R., 1964. Swedish Myxomycetes. Svenks. Bot. Tidsk. 58(1):113-124.

Schinner, F., 1982. Myxomycetes des Gloβglockner Gabietes (Hohe Tauern, Oesterreich) eine okologische studie. Z. Mycol. 48(1):165-170.

Stephenson, S.L., 1988. Distribution and ecology of Myxomycetes in temperate forest. I. Patterns of ocurrence in the upland forest of Southwestern Virginia. Can. J. Bot. 66:2187-2207.

Stojanowska, W., 1983. Myxomycetes of the Sudetes I. Acta Mycol. 19(2):207-243.

U.S. Department of Agriculture, 1975. Munsell Soil Color Charts. Kollmorgen, Maryland.

Villarreal, L., 1983. Algunas especies de Myxomycetes no registradas del estado de Veracruz. Bol. Soc. Mex. Mic. 18:153-164.

Villarreal, L., 1990. Estudios sobre los Myxomycetes de México I. Nuevos registros. Mic. Neotrop. Aplic. 3:67-79.

Yu, L. & L. Hui-Zhong, 1989. Myxomycetes from China I. Mycotaxon 35(2):429-436.

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A NEW SPECIES OF PUCCINIA FROM INDIA

by

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SUMMARY

A new species of Puccinia (Puccinia bakshii De,sp.nov.)has been described and illustrated. The species was found growing on the leaves of Oxalis corniculata L. at Darjeeling,West Bengal,India.

During a survey of fungi of Eastern Himalayas (India) a rust fungus was collected by the author in October,1991 which was found growing on the leaves of Oxalis corniculata L. at Darjeeling (altitude 6,800 ft.), West Bengal.India.After investigations it was found to be a new species of the genus Puccinia Pers. Complete descriptions of urediniospores, teliospores and basidiospores of this species have been presented herein and the name coined for this fungus is :

Puccinia bakshii De,sp.nov.

Urediniis minutis,epiphyllis,sparsus,superiori foliorum,subepidermalibus, erumpentis,pulverulentis,pallide flavus;urediniosporis 16.5-19.8 x 16.5-18.5 µm,stipitatis,globosis,hyalinus ad pallide flavus,membrana 0.8-1.0 µm crassa,echinulata,poris germinationis 3 vel 4,equatorialibus;paraphysibus nullis.

Teliis minutis,epiphyllis,sparsus,subepidermalibus, erumpentis,pallide flavus;teliosporis stipitatis,ellipsoideae,rotundatus in ambabus extremitatibus,23.0 - 25.0 x 14.8-16.5 µm, hyalinus ad pallide flavus,membrana 0.5 µm crassa.

Basidia hyalina,4-sterigmatibus; basidiosporae ovato,hyalinae,tenuitunicatae,8.2-9.9 x 6.0-7.0 µm.

HOLOTYPUS lectus ad locum Darjeeling,West Bengal,India, die 27 Octobri, 1991 et positus in herbario fungorum in sectio Botanicae,Burdwan Raj College,Burdwan,West Bengal,India (sub numero BRCMH R-911); in herb. Kew conservatus.

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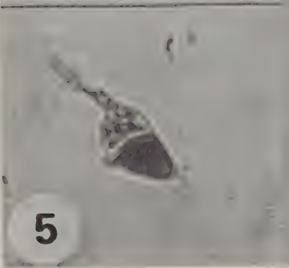
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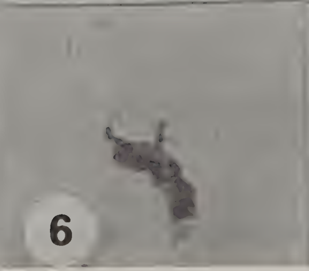
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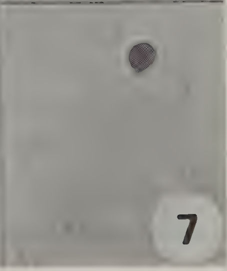
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Uredinia (Fig.1) minute,epiphyllous,scattered over the entire leaf, subepidermal,erumpent,pulverulent,pale yellow;urediniospores (Fig.2)16.5-19.8 x 16.5-18.5 µm, stalked,globose to ellipsoid,hyaline to pale yellow, wall 0.8-1.0 µm thick, echinulate, germpores 3-4,equatorial; paraphysis absent.

Telia (Fig.1) minute, epiphyllous,scattered,subepidermal,erumpent, pale yellow;teliospores (Figs.3,4,5) stipitate,ellipsoid,round at both the ends,slightly constricted at septum, 23.0-25.0 x 14.8-16.5 µm, hyaline to pale yellow,wall 0.5 µm thick.

Basidia (Fig.6) hyaline,tetrasterigmatic;basidiospores (Fig.7) ovate, hyaline,thin-walled,8.2-9.9 x 6.0-7.0 µm.

HOLOTYPE : BRCMH R-911,October 27,1991. Kept in the Mycological Herbarium, Department of Botany,Burdwan Raj College,Burdwan,West Bengal,India. A portion of the specimen has been deposited in the Kew Herbarium,Richmond, Surrey, England.

TYPE LOCALITY: Darjeeling,West Bengal, India.

ETYMOLOGY: The specific epithet after the celebrated mycologist of India Dr.B.K.Bakshi.

REMARKS: Puccinia bakshii De is distinct from any known species of Puccinia Pers. due to the following features:
(i) it grows on leaves of Oxalis corniculata showing pale yellow epiphyllous uredinia and telia; (ii) urediniospores and teliospores are very slightly thick-walled and hyaline to pale yellow in colour;(iii) urediniospores globose,16.5-19.8 x 16.5-18.5 µm; (iv) teliospores ellipsoid, round at both the ends, slightly constricted at septum, 23.0-25.0 x 14.8-16.5 µm; (v) basidiospores ovate, 8.2-9.9 x 6.0-7.0 µm.

Figs.1 - 7. Puccinia bakshii (holotype): 1. infected leaves of Oxalis corniculata showing uredinia and telia(x1/2);2. single urediniospore (x900);3.teliospores(x400);4.single teliospore(x500);5.germinated teliospore (X500);6.basidium(x500); 7.single basidiospore(x400).

It may be mentioned here that *Puccinia bakshii* shows close similarity with *Puccinia oxalidis* Dietel et Ellis.Both of them produce urediniospores and teliospores on the leaflets of *Oxalis* and in both of them the uredinia are pale yellow in colour.But these two species differ from each other by the following features:(i)*P.oxalidis* grows on *Oxalis corymbosa* and *Oxalis latifolia*,(ii) produces hypophyllous uredinia and telia, and (iii) its telia are brownish yellow (Ellis and Ellis 1985) whereas (i) *P.bakshii* grows on *Oxalis corniculata*,(ii) produces epiphyllous uredinia abd telia, and (iii) its telia are pale yellow. Besides,urediniospores and teliospores of *P.oxalidis* are larger than those of *P.bakshii*. Considering the host,the position of the uredinia and telia,and the characters of the urediniospores and teliospores it can be concluded that *Puccnia bakshii* is distinct from any known species of *Puccinia*. Hence it is described here as new species.

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REFERENCES

Ellis,M.B.and J.P.Ellis.1985.Microfungi on Land Plants - An Identificaion Handook.Biddles Ltd.,Guildford and King's Lynn,Great Britain.

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NEW SPECIES AND COMBINATIONS IN THE LICHEN GENUS PARMOTREMA (ASCOMYCOTINA, PARMELIACEAE) FROM MALAYSIA AND PAPUA NEW GUINEA

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ABSTRACT: The following new species are described: *Parmotrema barioense* Elix, Din & Ismail from Sarawak, Malaysia and *Parmotrema naonii* Elix from Papua New Guinea. In addition the new combinations *Parmotrema bogoriense* (Zahlbr.) Elix and *Parmotrema neocaledonicum* (Nyl.) Elix are made.

Introduction

As a result of further study of the lichen family Parmeliaceae in Australasia and Malaysia (Din, Ismail & Elix 1996; Elix 1995), we are describing two new species. Throughout the present work chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson *et al.* 1981; Culberson & Johnson 1982; Elix & Ernst-Russell 1993; Elix *et al.* 1988), high performance liquid chromatography (Feige *et al.* 1993) and comparison with authentic samples.

Parmotrema barioense Elix, Din & Ismail, sp. nov. Fig. 1

Species cum thallo ut in *Parmotrema zollingeri* sed ab hac specie lobis late convolutis, sporis majoribus et butlerino D, butlerino E and butlerino continente differt.

Type: Malaysia. Sarawak. Kerangas Forest, Bario, 3°44'N, 115°28'E, 1220 m, on tree, *L. B. Din, I. B. Ipor & B. A. Fasihuddin B44* ; holo: UNIMAS; iso: CANB.

Thallus corticolous, loosely adnate, membranaceous, 10-12 cm wide. *Lobes* rounded, 6-20 mm wide, older central lobes broadly convoluted and saccate, ±short-laciniate; margins sparingly ciliate, cilia short, to 1 mm long. *Upper surface* pale grey to ash-grey, emaculate, smooth, slightly rugose and cracked in older parts, lacking soredia and isidia. Medulla white. *Lower surface* black to the margins, rhizines short, sparse, situated in the central parts of the thallus. *Apothecia* short-stipitate, laminal, 3-8 mm wide; disc imperforate, concave then undulate-distorted, cinnamon-brown; thalline exciple maculate, becoming cracked; spores 21-27 x 9-13 µm. *Pycnidia* common, mature conidia not seen.

Chemistry. Cortex K+ yellow; medulla K+ pale yellow-brown, C-, P+ red-orange; containing atranorin (minor), chloroatranorin (minor), protocetraric acid (minor), butlerin D (major), butlerin E (minor), butlerin F (minor).

Morphologically this new species resembles *Parmotrema zollingeri* (Hepp) Hale, since both have membranaceous thalli, sparse, short cilia and contain protocetraric acid in the medulla. *P. barioense* is distinguished by the broadly convoluted lobes in the centre of the thallus (more or less flat in *P. zollingeri*), the larger spores (21-27 x 9-13 *cf.* 18-22 x 8-10 µm) and by the presence of butlerin derivatives in the medulla. The butlerin derivatives are a unique group of lichen terphenyls, previously known from two species of *Relicina, R. connivens* (Kurok.) Hale and *R. kurandensis* Elix (Elix 1996; Elix & Ernst-Russell 1996; Elix *et al.* 1995). Biogenetically these compounds are closely related to the terphenylquinones (e.g. polyporic acid) which occur in several lichens, but are more common in non-lichenized basidiomycetes.

Parmotrema naonii Elix, sp. nov. Fig. 2

Species cum thallo ut in *Parmotrema mellissii* sed ab hac specie thallo parviore, eciliato, lobis angustioribus et acido protocetrarico continente differt.

Type: Papua New Guinea. Central Province. Musgrave River Road, Itikinumu Plantation, 16 km east of Sogeri, 9°25'S, 147°27'E, 700 m, on *Hevea* trunk in rubber plantation on gentle slope, *H. Streimann 16015 & E. K. Naoni*, 12 Feb. 1981; holo: CANB; iso H, LAE, UPNG, US.

Thallus corticolous, membranaceous, loosely adnate, 5-10 cm wide. *Lobes* 0.5-1.5 cm wide, ascending and revolute at apices; marginal lobes rotund, eciliate or very sparingly ciliate in axils. *Upper surface* pale grey, emaculate, pitted or weakly rugulose, sorediate; soralia marginal and submarginal, produced mainly on secondary laciniae which extend from the apices of revolute, older, central lobes, laciniae becoming subterete, isidioid and sorediate with age, soredia granular. *Medulla* white. *Lower surface* black, with a narrow, dark brown marginal zone; rhizines occurring in scattered dense, groups; rhizines long, slender, simple or commonly furcately branched. *Apothecia* and pycnidia not seen.

Chemistry. Cortex K+ yellow, medulla K+ pale yellow-brown, C-, P+ red; containing atranorin (minor), chloroatranorin (minor), protocetraric acid (major).

This new species resembles *Parmotrema mellissii* (Dodge) Hale in that both have membranaceous thalli and produce characteristic marginal sorediate-isidia and/or sorediate laciniae. Ultimately the propagules are similar in these two species, but originate in alternative ways. The propagules in *P. mellissii* appear as marginal and submarginal soralia producing granular soredia, here and there interspersed with coarse, ciliate isidioid outgrowths which become sorediate with time. However, in *P. naonii* they orginate as narrow, apical laciniae which become densely sordiate and subterete. Furthermore, *P. mellissii* is densely ciliate and contains alectoronic and α-collatolic acids (UV+ blue-white, P-), while *P.naonii* is virtually eciliate and contains protocetraric acid (UV-, P+ orange-red). *P. naonii* also resembles the Brazilian species, *Parmotrema schindleri* Hale. Although both contain protocetraric acid, *P. schindleri* contains additional gyrophoric acid, is saxicolous, lacks the subisidioid laciniae and has sparse, simple rhizines rather than groups of dense, furcate branched rhizines. At present *P. naonii* is only known from the type collection from the highlands of Central Province, Papua New Guinea, while *P. mellissii* is common pantropical species.

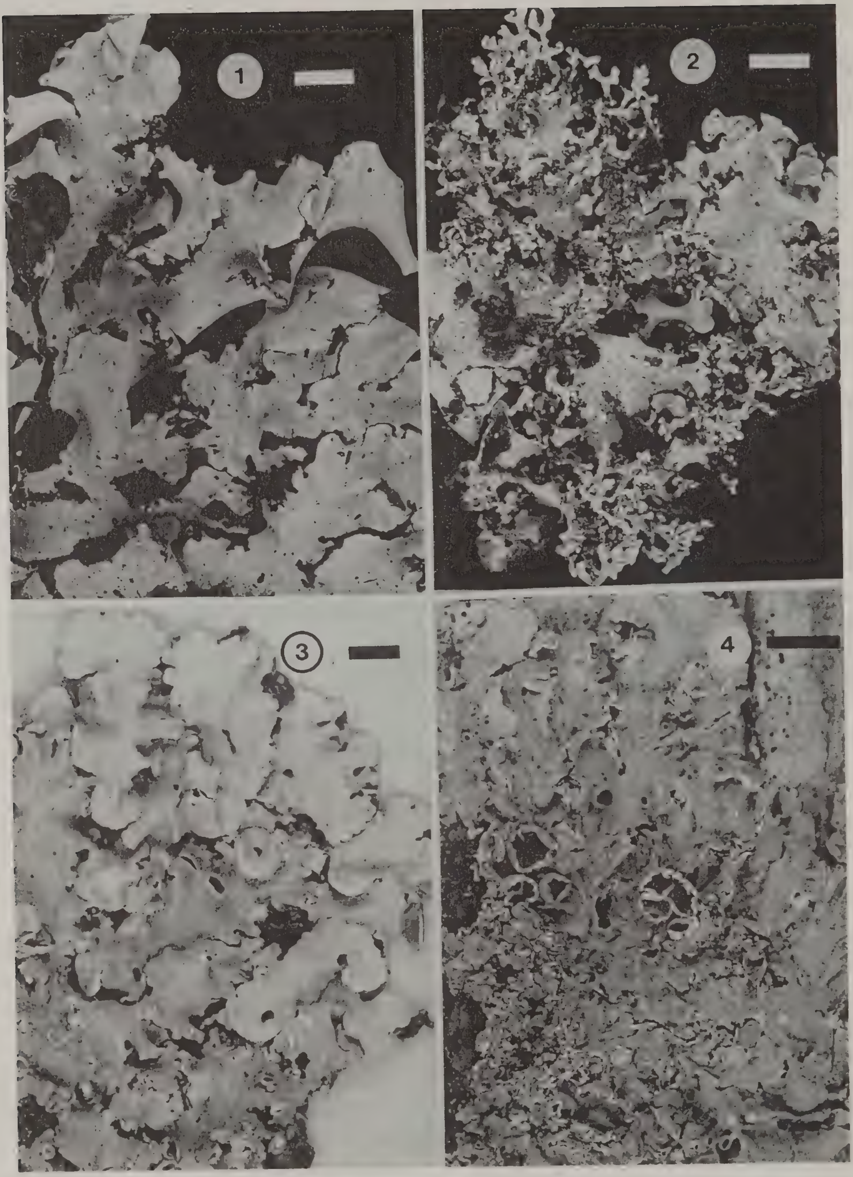
New Combinations

Parmotrema bogoriense (Zahlbr.) Elix, comb. nov. Fig. 3

Basionym. *Parmelia bogoriensis* Zahlbr., *Ann. Crypt. Exot.*, **1**: 206 (1928).

Type: Indonesia. Java, Buitenzorg Garden, *Overeem* 4; holo: W; iso: BO, MICH.

Thallus orbicular, loosely adnate, coriaceous, up to 14 cm wide. *Upper surface* grey-white, dull, irregularly lobate, marginal lobes rotund, sinuous, 7-20 mm wide, ± convex, margins ascending, smooth, ciliate, cilia black, thin, simple, 0.4-2 mm long, moderately dispersed; central lobes imbricate, concave, becoming darker grey, here and there granulose-verruculose or in the outer lobules sparsely subverruculose; soredia and isidia absent. *Lower surface* with a broad, naked zone near the margin, shiny, red-brown, black towards the centre, dull, moderately densely rhizinate, rhizines short.



Figures 1-4. Species of *Parmotrema*: 1, *Parmotrema barioense* (isotype in CANB); 2, *Parmotrema naonii* (holotype in CANB); 3, *Parmotrema bogoriense* (holotype in W); 4, *Parmotrema neocaledonica* (holotype in H). Scale bar = 5 mm.

Medulla white. *Apothecia* laminal, sessile to subpedicellate, to 10 mm wide; thalline exciple inflexed, subcrenulate at first, then verruculose; disc pale brown to dark red-brown, imperforate; ascospores 19-25 x 7.5-8 µm. Pycnidia not seen.

Chemistry. Cortex K+ yellow; medulla K-, C-, KC-, P+ brick red; containing atranorin (minor), chloroatranorin (minor), fumarprotocetraric acid (major), succinprotocetraric acid (submajor), protocetraric acid (minor).

This species is close to *P. queenslandense* which has similar chemistry, coriaceous thalli and lacks soredia and isidia. However, *P. queenslandense* lacks the verruculose upper surface (these almost appear to be initials for isidia in *P. bogoriensis,* particularly on the margins of the apothecia) and is always saxicolous while *P. bogoriense* is corticolous. Further, *P. queenslandense* lacks cilia and has smaller spores (10-17 x 5-7 *cf.* 19-25 x 7.5-8 µm). *P. bogoriense* differs both morphologically and chemically from *P. zollingeri* (Hepp) Hale, with which it was formerly considered synonymous (Hale 1965). In particular, *P. zollingeri* contains medullary protocetraric acid, has a membranaceous thallus with flatter lobes and does not develop the granulose-verruculose upper surface so characteristic of *P. bogoriense.*

Parmotrema neocaledonicum (Nyl.) Elix, comb. nov. Fig. 4

Basionym. *Parmelia neocaledonica* Nyl., *Flora*, **68**: 609 (1885).

Type: New Caledonia, Wagup, *Vieillard*; holo: H-NYL. herb. no. 35304.

= *Pseudoparmelia concomitans* Hale, *Smithsonian Contr. Bot.*, **31**: 24 (1976).

Type: New Caledonia, Baie des Crabes, Ile de Pins, on fallen branch of *Araucaria cookii, D. J. Hill 12124*; holo: BM; iso US.

Thallus corticolous, adnate, coriaceous, pale mineral grey, 6-10 cm wide. *Lobes* 7-10 mm wide, rounded, entire or weakly crenate, eciliate, central lobes more or less laciniate. *Upper surface* emaculate, smooth, slightly rugose in older parts, lacking soredia and isidia. Medulla white. *Lower surface* black, with a dark brown marginal zone, rhizines short, sparse, situated in the central parts of the thallus. *Apothecia* short stipitate, laminal, 1-5 mm wide, disc imperforate, concave, thalline exciple faintly maculate; spores 16-29 x 9-14 µm. *Pycnidia* rare, conidia sublageniform, 7-9 x 1 µm.

Chemistry. Cortex K+ yellow, medulla K+ pale yellow-brown, C+ pink, P+ red-orange; containing atranorin (minor), chloroatranorin (minor), protocetraric acid (minor), gyrophoric acid acid (major).

This species is morphologically similar to *P. zollingeri* (Hepp) Hale with which it was previously synonymized (Hale 1965), but is more tightly adnate, has narrower lobes (7-10 *cf.* 10-18 mm wide), somewhat larger spores (16-29 x 9-14 *cf.* 18-22 x 8-10 µm) and differs in medullary chemistry. Whereas *P. zollingeri* contains protocetraric acid and ±fatty acids, gyrophoric acid is the major metabolite of *P. neocaledonicum.*

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LITERATURE CITED

Culberson, C. F. (1972). Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. *Journal of Chromatography* **72**: 113-125.

Culberson, C. F., Culberson, W. L. and Johnson, A. (1981). A standardized TLC analysis of β-orcinol depsidones. *Bryologist* **84**: 16-29.

Culberson, C. F. and Johnson, A. (1982). Substitution of methyl *tert.*-butyl ether for diethyl ether in the standardized thin-layer chromatographic method for lichen products. *Journal of Chromatography* **238**: 483-487.

Din, L. B., Ismail, G., and Elix, J. A. (1996). Additional lichen records from Indonesia and Malaysia 3. New Records from Borneo. *Australasian Lichenological Newsletter* **39**: 16-19.

Elix, J. A. (1995). New species in the lichen family Parmeliaceae (Ascomycotina) from Australasia and Malaysia. *Mycotaxon* **56**: 231-241.

Elix, J. A. (1996). A revision of the lichen genus *Relicina. Bibliotheca Lichenologica,* in press.

Elix, J. A., and Ernst-Russell, K. D. (1993). *A Catalogue of Standardized Thin Layer Chromatographic Data and Biosynthetic Relationships for Lichen Substances,* 2nd Edn. (Australian National University, Canberra).

Elix, J. A., Gaul, K. L., Hockless, D. C. R., and Wardlaw, J. H. (1995). Structure determination of butlerins A, B and C - three new lichen *p*-terphenyls. *Australian Journal of Chemistry* **48**: 1049-1053.

Elix, J. A., Johnston, J. and Parker, J. L. (1988). A Computer Program for the Rapid Identification of Lichen Substances. *Mycotaxon* **31**: 89-99.

Feige, G. B., Lumbsch, H. T., Huneck, S. and Elix, J. A. (1993) The identification of lichen substances by a standardized high-performance liquid chromatographic method. *Journal of Chromatography* **646**: 417-427.

Hale, M. E. (1976). A monograph of the lichen genus *Pseudoparmelia* Lynge (Parmeliaceae). *Smithsonian Contributions to Botany* **31**: 1-62.

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ANNOTATED LIST OF THE HYSTERIACEAE (DOTHIDEALES, ASCOMYCOTINA) REPORTED FROM THE IBERIAN PENINSULA AND BALEARIC ISLANDS

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ABSTRACT

A checklist of the hysteriacean fungi of the Iberian Peninsula and Balearic Islands, based on bibliographic data has been compiled. Material of those species included in this catalogue which was available from different herbaria has been revised. Nomenclatural problems are commented under the "Observations".

INTRODUCTION

Because of the absence of previous data and the great diversity of the vegetation of our country, studies on the spanish mycoflora are very interesting. Therefore, in 1988 the DGICYT (Dirección General de Investigación Científica Y Técnica) in collaboration with the "Real Jardín Botánico de Madrid" (CSIC, Consejo Superior de Investigaciones científicas) provided financial support to the Project "Flora Micológica Ibérica". The first results of these studies [on *Corticiaceae (Aphyllophorales)* and *Myxomycetes*] where published by the CSIC as different chorological papers: "Cuadernos de Trabajo

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de Flora Micológica Ibérica" (ALMARAZ, 1996; CARDOSO & MELO, 1992; LADO, 1993; PANDO, 1991, 1996; PANDO & al., 1990; SANTAMARIA, 1996; TELLERIA, 1991, 1992, 1993).

The present paper presents the preliminary results of the studies on *Dothideales* (bitunicate ascomycetes), starting with a checklist of the family *Hysteriaceae*.

MATERIALS AND METHODS

A catalogue has been compiled of all the generic, specific and infraspecific taxa of the *Hysteriaceae* recorded in the Iberian Peninsula (Portugal and Spain) and Balearic Islands based on bibliographic data. Material of those species included in this catalogue which was available from different herbaria has been revised.

The methodology followed in this project was discussed by TELLERIA (1990).

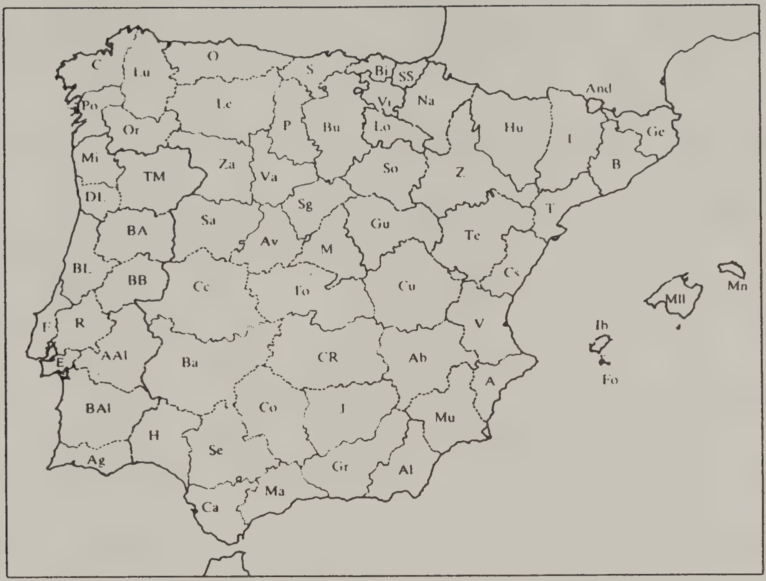
Every taxon is accompanied with information about its chorology (see the map with the symbols of each province, fig. 1; a number between parentheses indicates the bibliographic reference where the taxon is cited) substrate and the herbaria where the material is deposited. Data about herbaria have been taken from different papers as well as from personal communications. In those cases with nomenclatural problems I have add some comments in a paragraph called "observations".

At the end of the catalogue, there is a list which includes all doubtful and excluded taxa.

The nomenclature is based on ZOGG (1962).

HERBARIA

The herbaria where the material is deposited is indicated. As most of them maybe unfamiliar I include a list with their corresponding addresses below.



ESPAÑA (ESP)
A Alicante
Ab Albacete
Al Almeria
Av Avila
B Barcelona
Ba Badajoz
Bi Vizcaya
Bu Burgos
C La Coruña
Ca Cádiz
Cc Cáceres
Co Córdoba
Cs Castellón
CR Ciudad Real
Cu Cuenca
Ge Gerona
Gr Granada
Gu Guadalajara
H Huelva
Hu Huesca
J Jaén
L Lérida
Le León
Lo La Rioja
Lu Lugo
M Madrid
Ma Málaga
Mu Murcia
Na Navarra
O Asturias
Or Orense
P Palencia
Po Pontevedra
S Cantabria
Sa Salamanca
Se Sevilla
Sg Segovia
So Soria
T Tarragona
Te Teruel
To Toledo
V Valencia
Va Valladolid
Z Zaragoza
Za Zamora

BALEARES
Fo Formentera
Ib Ibiza
Mll Mallorca
Mn Menorca

PORTUGAL (PRT)
AAl Alto Alentejo
BA Beira Alta
BAl Bajo Alentejo
BB Beira Baixa
BL Beira Litoral
DL Douro Litoral
E Estremadura
Mi Minho
R Ribatejo
TM Trás-os-Montes

Fig. 1.- Symbols of each province.

AH.- Departamento de Biología Vegetal. Facultad de Ciencias.Universidad de Alcalá de Henares, 28871 Madrid. Spain.

BCC-DSL or **DSL.**- Private herbarium of D. Sierra. Departamento de Biología Vegetal, Facultad de Biología, Universidad de Barcelona. 08071 Barcelona. Spain.

HJCh.-GM.- Private herbarium of J.Checa & G. Moreno, deposited in AH.

I. Melo.- Private herbarium of I. Melo. Museo e Jardim Botânico. Universidade de Lisboa. Rua da Escola Politécnica 58. 1200 Lisboa. Portugal.

JL.- Private herbarium of J. Larios. Departamento de Biología Vegetal, Facultad de Biología. Universidad de Murcia. 30071 Murcia. Spain.

LISE.- Fitosistemática e Geobotânica, Estaçao Agronómica Nacional. P-2780. Oeiras. Portugal.

LISFA.- Conservaçao dos Recursos Naturais, Estaçao Florestal Nacional de Investigaçao Agrária, P-130. Lisboa. Portugal

LISVA.- Laboratório de Patologia Vegetal Veríssimo de Almeida. Ministerio de Educaçao. Tapada da Ajuda. P-1300. Lisboa. Portugal.

MA-Fungi.- Real Jardín Botánico, C.S.I.C., PLaza de Murillo 2. 28014 Madrid. Spain.

MHG.- Private herbarium of M. Honrubia. Departamento de Biología Vegetal, Facultad de Biología. Universidad de Murcia. 30071 Murcia. Spain.

MUB.- Departamento de Biología Vegetal, Facultad de Biología. Universidad de Murcia. 30071 Murcia. Spain.

BIBLIOGRAPHY SURVEYED FOR THE COMPILATION OF THE CATALOGUE

1).- AMO Y MORA, M., DEL (1870). Flora Criptogámica de la Península Ibérica. España y Portugal. Ed. Imprenta Indalecio Venturada. Granada.

2).- ANDRÉS Y TUBILLA, T. & LÁZARO E IBIZA, B. (1881). Enumeración de los hongos de la provincia de Madrid. Soc. Linn. Matritense 1881:27-31.

3).- ANÓNIMO (1976). Catálogo Micológico de Alava.A.E.P.N.A. Diputación Foral de Alava. Sección de Ciencias. Vitoria.

4).- ARANDA, A.C. (1987). Contribución al estudio de los Ascomycetes: Gloniopsis praelonga (Sch.) Zogg. Belarra 1(1):37-40.

5).- ARANDA, A.C. & MUÑOZ, J.A. (1990). Estudio Micológico del bosque de La Calera del Prado de Karrantza (Bizkaia) Parte I. Belarra 7: 101-120.

6).- ARANZADI, T.(1897). Setas u hongos del País Vasco. Librería de Romo y Füssel. Madrid.

7).- BERTAULT, R. (1982). Contribution à la Flore Mycologique de la Catalogne. Acta Bot. Barcinon. 34:1-35.

8).- CALONGE, F.D. & TELLERÍA, M.T. (1980). Introducción al conocimiento de los hongos de Doñana (Huelva, España). Lazaroa 2:271-326.

9).- CALONGE, F.D., ROCABRUNA, A., TABARES, M. & SIERRA, D. (1986). Contribución al estudio de los Ascomycotina españoles. III. Un género y ocho especies nuevas para el catálogo. Butl. Soc. Catalana Micol. 10:35-47.

10).- CALONGE, F.D., TORRE, M. DE LA, TELLERÍA, M.T. & VERDE DE MILLAN,L. (1978). Aportación al catálogo de los hongos del Real Jardín Botánico de Madrid. Bol. Estac. Centr. Ecol. 7(13):33-47.

11).- CÂMARA, M. SOUSA (1946). Contributiones ad mycofloram Lusitaniae. Centuria XII. Agron. Lusit. 8(1):19-71.

12).- CÂMARA, M. SOUSA (1947). MYCETES ALIQUOT LUSITANIAE VII. AGRON. LUSIT. 9(2):85-128.

13).- CÂMARA, M. SOUSA (1948). Enumeraçao dos micetas encontrados até agora nas oliveiras, em Portugal, e particularmente algumas consideraçoes sobre as doenças mais vulagares e mais perigosas da mesma árvore, a eles devidas. II Congr. Ribatejano:407-424.

14).- CÂMARA, M. SOUSA (1949). Mycetes aliquot Lusitaniae IX. Agron. Lusit. 11(1): 39-73.

15).- CÂMARA, M. SOUSA (1949). Mycetes aliquot Lusitaniae X. Agron. Lusit. 11(3): 165-189.

16).- CÂMARA, M. SOUSA (1950). Catalogus Fungorum Juresi (Serra do Gerês) ad Mycofloram Lusitanicam. Agron. Lusit. 12(1):89-122.

17).- CÂMARA, M. SOUSA (1951). Mycetes aliquot Lusitaniae XI. Agron. Lusit. 13(2):117-151.

18).- CÂMARA, M. SOUSA (1951). Mycetes aliquot Lusitaniae XII. Agron. Lusit. 13(3): 185-212.

19).- CÂMARA, M. SOUSA & LUZ, C.G. (1939). Mycetes aliquot Lusitaniae II. Agron. Lusit. 1(1):41-63.

20).- CÂMARA, M. SOUSA & LUZ, C.G. (1939). Mycetes aliquot Lusitaniae III. Agron. Lusit. 1(2):167-199.

21).- CÂMARA, M. SOUSA & LUZ, C.G. (1943). Mycetes aliquot Lusitaniae VI. Agron. Lusit. 5(2):119-145.

22).- CHECA, J., (1986). Estudio de la clase Pyrenomycetes s. lato (Ascomycotina) en España (Guadalajara, Madrid y Segovia). Univ. Alcalá de Henares (Madrid, Spain). (Tesis doctoral inédita).

23).- CHECA, J., (1990). Estudios sobre Pyrenomycetes y Loculoascomycetes (Ascomycotina),V. Dothideales y Lecanidiales. Bol. Soc. Micol. Madrid 14:99-106.

24).- CHECA, J. (1994). Pyrenomycetes s. lato de reservas naturales ibéricas. Bol. Soc. Micol. Madrid 19:3-14.

25).- CHECA, J. (1996). Pyrenomycetes s. lato de reservas naturales ibéricas. II. Portug. Acta Biol., Sér.B. (in print).

26).- CHECA, J. & MORENO, G. (1982). Contribución al estudio de los hongos que fructifican sobre Fagus sylvatica L. en el Puerto de la Quesera (Segovia). Bol. Soc. Micol. Castellana 7:105-134.

27).- CHECA, J. & MORENO, G. (1984). Estudios sobre Pyrenomycetes y Loculoascomycetes (Ascomycotina).I. Bol. Soc. Micol. Castellana 8:15-22.

28).- CHECA, J. & MORENO, G. (1985) .Estudios sobre Pyrenomycetes Loculoascomycetes (Ascomycotina).II. Bol. Soc. Micol. Castellana 9:5-14.

29).- COLMEIRO, M. (1867). Enumeración de las Criptógamas de España y Portygal. Rev. Progr. Ci. Exact. 17:548-590.

30).- COSTA, M.E. & CÂMARA, M. SOUSA (1954). Species aliquae mycologicae Lusitaniae.III. Portugaliae Acta Biol., Ser. B. Sist. 4(3-4):331-345.

31).- DENNIS, R.W.G. & REID, D.A. (1956). October fungi in Portugal. Revista Biol. (Lisboa) 1(1):21-27.

32).- DIAS, M.R. SOUSA (1956). Fungi Lusitaniae. XV. Agron. Lusit. 18(4):237-242.

33).- DIAS, M.R. SOUSA & CÂMARA, M. SOUSA (1952). Fungi Lusitaniae.Agron. Lusit. 14(2):101-125.

34).- DIAS, M.R. SOUSA & LUCAS, M.T. (1965). Fungi Lusitaniae. XX. Agron. Lusit. 26(1):5-19.

35).- DIAS, M.R. SOUSA & LUCAS, M.T. (1972). Fungi Lusitaniae. Agron. Lusit. 33(1/4): 173-184.

36).- DIAS, M.R. SOUSA & LUCAS, M.T. (1974). Fungi Lusitaniae. XXIV. Agron. Lusit. 35(2):137-144.

37).- DIAS, M.R. SOUSA, LUCAS, M.T., SAMPAIO, M.H. & SANTOS (1971). Fungi. In: Catálogo das plantas herborizadas. III Reuniao de Botânica Peninsular. Mem. Soc. Brot., Sér. 2, 21: 65-89.

38).- ESTEVE-RAVENTÓS, F. & MORENO, G. (1984). Contribución al estudio de los hongos que fructifican en el hayedo de Montejo de la Sierra (Madrid). Bol. Soc. Micol. Castellana 8:113-138.

39).- GALMÉS, G., (1928). Hongos encontrados en España que viven sobre pinos. Revista Fitopatol. :43-49.

40).- GARCÍA BONA, L.M. (1987). Catálogo micológico de Navarra. Cuad. Secc. Ci. Nat. 3:9-287.

41).- GARCÍA BONA, L.M. (1989). Los carrascales navarros. Estudio florístico y micológico. Cuad. Secc. Ci. Nat. 5:193-363.

42).- GONZÁLEZ FRAGOSO, R. (1914). Contribución a la flora miológica de Guadarrama. Pireniales.

Histeriales. Discales. Trab. Mus. Nac. Ci.Nat., Ser. Bot. 4:1-43.

43).- GONZÁLEZ FRAGOSO, R. (1916). Bosquejo de una Flórula Hispalense de Micromicetos. Trab. Mus. Nac. Ci. Nat., Ser. Bot. 10:1-221.

44).- GONZÁLEZ FRAGOSO, R. (1917). Fungi novi vel minus cogniti Horti Botanici Matritensis. Trab. Mus. Nac. Ci. Nat., Ser. Bot. 12:1-99.

45).- GONZÁLEZ FRAGOSO, R. (1919.). Anotaciones micológicas. Hongos de Cataluña. Mem. Real Soc. Esp. Hist. Nat. 11:77-103.

46).- GONZÁLEZ FRAGOSO, R. (1923). Contribución a la flora micológica lusitánica. Bol. Soc. Brot., Sér. 2, 2:3-83.

47).- HONRUBIA, M., ALCARAZ, F., GRACIA, E. & LLIMONA, X. (1982). El componente fúngico de las principales comunidades vegetales del SE de España. Lazaroa 4:313-325.

48).- HONRUBIA, M., BERTAULT, R. & LLIMONA, X.(1982). Aportación al conocimiento de los hongos del S.E. de España XIII. Plectomicetes. Loculoascomicetes. Pirenomicetes. Int. J. Mycol. Lichenol. 1(1):1-26.

49).- HONRUBIA, M., LARIOS, J.M. & GALLEGO, E.(1985). Notas sobre Ascomycotina en el S.E. de España peninsular. Anales Jard. Bot. Madrid 42(1):39-48.

50).- KNOCHE, H.(1921). Flora Balearica. Étude phytogéographique sur les illes Baléares vol. 1. Imp. Rouxégos et Déhan. Montpellier.

51).- LACOIZQUETA, J.M. (1885). Catálogo de las plantas que espontáneamente crecen en el Valle de Vertizarana (conclusión). Anales. Soc. Esp. Hist. Nat. 14 (Memorias):185-238.

52).- LARIOS, J.M. & HONRUBIA, M. (1988). Hysteriaceae Chev. y Lophiaceae Zogg ex Arx & Müller (Ascomycotina) en el Sudeste de la Península Ibérica. Rev. Ibér. Micol. 5(3):111-117.

53).- LARIOS, J.M., HONRUBIA, M. & MORENO, G.(1986). ESTUDIO DE LOS HONGOS QUE FRUCTIFICAN EN LA VEGETACIÓN

RELICTA DE ABIES PINSAPO BOISS., EN ESPAÑA PENINSULAR. I. ASCOMYCOTINA. ACTA BOT. MALACITANA 11:39-53.

54).- LARIOS, J.M., HONRUBIA, M. & MORENO, G. (1988). Estudio de los hongos que fructifican en la vegetación relicta de Abies pinsapo Boiss., en España peninsular. II. Ascomycotina. Acta Bot. Malacitana 13:91-110.

55).- LÓPEZ DE SILANES, M.E. & CARBALLAL, R. (1987). Líquenes epífitos de Caaveiro, La Coruña (España),I. Cryptog. Bryol. Lichénol. 8(4):359-367.

56).- LOSA ESPAÑA, T.M. (1949). Micromicetes del Pirineo español. Anales Jard. Bot. Madrid 8:297-338.

57).- LOSANTOS, A.P., BASCONES, J.C., EDERRA, A. & MEDRANO MORENO, L.M. (1982). Notas micológicas. Navarra. II. Aportaciones al catálogo micológico de Navarra. Collect. Bot. (Barcelona) 13(2):365-642.

58).- LOSANTOS, A.P., BASCONES, J.C., EDERRA, A. & LÓPEZ-FERNANDEZ, M.L. (1983). Catálogo de Ascomycetes de Navarra. Publ. Biol. Univ. Navarra, Ser. Bot. 3:3-33.

59).- LOSCOS, F. (1886). Tratado de las plantas de Aragón con suplementos. Edición del Seminario Farmaceútico. Madrid.

60).- LUCAS, M.T. & CÂMARA, M. SOUSA (1952). Fungi Lusitaniae II. Agron. Lusit. 14(3): 193-227.

61).- LUCAS, M.T. & CÂMARA, M. SOUSA (1953). Fungi Lusitaniae. V. Agron. Lusit. 15(2): 153-182.

62).- LUCAS, M.T. & CÂMARA, M. SOUSA (1954). Fungi Lusitaniae. VIII. Agron. Lusit. 16(2):81-109.

63).- MAIRE, R. (1905). Contributions à l'etude de la flore mycologique des Iles Baléares. Bull. Soc. Mycol. France 21(4):213-224.

64).- MALENÇON, G. & BERTAULT, R. (1972). Champignons de la Péninsule Ibérique . IV Les Iles Baléares. Acta Phytotax. Barcinon. 11:1-64.

65).- MELO, I. (1971). Contribuiçao para o conhecimiento dos Ascomycetes de Portugal. I.

Portugaliae Acta Biol., Sër. B., Sist. 11(3/4):248-257.

66).- MELO, I. (1974). Contribuiçao para o conhecimiento dos Ascomycetes de Portugal. II. Revista Fac. Ci. Univ. Lisboa, Sér. 2, C. Ci. Nat. 17(2): 451-458.

67).- MENÉNDEZ AMOR, J. (1955). La depresión caretana española y sus vegetales fósiles. Mem. Real Acad. Ci. Exact. Madrid 18:1-345.

68).- NIESSL, G. (1883). Contributiones ad floram mycologicam lusitanicam. Series IV. Instituto (Coimbra), Sér. 2, 31(3):133-143.

69).- REZENDE-PINTO, M.C. (1940). IV Contribuiçao para a flora criptogâmica do Norte de Portugal. Brotéria, Sér. Ci. Nat. 9(3): 113-130.

70).- ROLLAND, L. (1905). Champignons des Iles Baléares. Récoltés principalement dans la région montagneuse de Sóller (suite). Bull. Soc. Mycol. France 21(1):21-38.

71).- ROUMEGUÈRE, C. (1888). Fungi Europoei precipue Gallici exsiccati. Centurie XLIV.Rev. Mycol. (Tolouse) 10(37):8-17.

72).- SACCARDO, P.A. (1893). Florula mycologica lusitanica, sistens contributionen decimam ad eamden floram nec non conspectumfungorum omnium in lusitania hucusque observatorum. Bol. Soc. Brot. 11:9-70.

73).- SANTOS, A.C. & CÂMARA, M. SOUSA (1955). Fungi Lusitaniae. XIII. Agron. Lusit. 17(2/4):135-152.

74).- SIERRA, M.D.(1987). Aportación al conocimiento de los Ascomycetes (Ascomycotina) de Cataluña.Edic. especials de la Societat catalana de Micologia. vol. 1. Barcelona.

75).- SIERRA, D. (1988). Notas sobre Ascomycetes. Butl. Soc. Catalana Micol. 12:73-81.

76).- SIERRA, D. & CAMBRA, J. (1987). Notes micològiques I: Ascomicets del torrent de la Sequera (Tarragona). Butl. Soc. Catalana Micol. 11: 73-82.

77).- THÜMEN, F. (1878). Contributiones ad floram mycologicam lusitanicam. Jorn. Sci. Math. Phys. Nat. (Lisboa). 2. ed. 6(24):230-253. (1886).

78).- THÜMEN, F. (1879). Contributiones ad floram mycologicam lusitanicam. Series II. Instituto (Coimbra), Sér. 2, 27(4):162-168. 1879]

79).- THÜMEN, F. (1881). Contributiones ad floram mycologicam lusitanicam. Series III. Instituto (Coimbra), Sér. 2, 28(8): 359-370.

80).- TORREND, C. (1905). Terceira contribuiçao para o estudo dos fungos da regiao Setubalense. Brotéria, Sér. Ci. Nat. 4:207-211.

81).- UNAMUNO, L.M. (1921). Algunos datos nuevos para el estudio de la flora micológica de la provincia de Oviedo. Mem. Real Soc. Esp. Hist. Nat. t. extr.:150-168.

82).- UNAMUNO, L.M. (1932). Algunos Micromicetos nuevos o poco conocidos de la flora española. Bol. Soc. Esp. Hist. Nat. 32:439-448.

83).- UNAMUNO, L.M. (1941). Enumeración y distribución geográfica de los Ascomicetos de la Península Ibérica y de las Islas Baleares. Mem. Real. Acad. Ci. Exact. Madrid 8:1-403.

84).- URRÍES, M.J. (1933). Algunos datos para la flora española de micromicetos. Bol. Soc. Esp. Hist. Nat. 33:91-104.

85).- URRÍES, M.J. (1941). Datos para la flora española de micromicetos (segunda nota). Anales Jard. Bot. Madrid 1(1):59-78 [1940].

86).- VAYREDA Y VILA, E. (1882). Catálech de la Flora de la Vall de Nuria. Imp. Succesors de Ramirez. Barcelona.

87).- WILLKOMM, M. (1852). Fungi. In: M.Willkomm, Sertum Florae Hispanicae sive Enumeratio systematica omnium plantarum . Flora 35:536-539.

88).- WINTER, G. (1885). Contributiones ad floram mycologicam lusitanicam. Series VI. Bol. Soc. Brot. 3(1):50-64.

89).- WINTER, G. (1886). Contributiones ad floram mycologicam lusitanicam. Series VI. Instituto (Coimbra) 34(4):186-192.

90).- ZUBÍA E INCAZURIAGA, I. (1921). Reseña de la provincia de Logroño como Preliminar al conocimiento de la Flora de la Rioja. Imprenta y Libreria Moderna. Logroño.

CATALOGUE

HYSTERIACEAE Dumort., Anal. Fam.: 73, 75. 1829
Typus. -Hysterium Tode: Fr., Syst. mycol. 2: 579 (1823).

FARLOWIELLA Sacc., Syll. Fung. 9: 1101. 1891
Typus. -Farlowiella carmichaeliana (Berk.) Sacc.

Farlowiella carmichaeliana (Berk.) Sacc., Syll. Fung. 9: 1101. 1891.
≡ *Hysterium carmichaelianum* Berk., The English Flora 5: 294. 1836
Ind. Loc. -Scotland, Appin, bark of Quercus (BISBY & HUGHES, 1952).

Chorology.- ESP: Vi (3).

GLONIELLA Sacc., Syll. Fung. 2: 765. 1883
Typus. -Gloniella sardoa Sacc. & Traverso

Gloniella byssiseda (Crouan) Sacc., Syll. Fung. 2: 767. 1883

≡ *Mytilinidion byssisedum* Crouan, Florule du Finisterre: 30. 1867
Ind. Loc. -France, Bouleau, Pr. r., sur les bois mort de Saule.

Chorology.- PRT: Ag (37).
Substrate.- *Alnus glutinosa*.
Herbarium.- LISFA.

Gloniella sardoa Sacc. & Traverso, Ann. Mycol. 1: 435. 1903.
Typus.- In PAD. Italy, prope Sassari (Sardiniae), in

ligno denudato Populi albae, legit. A. N. Berlese.

Chorology.- ESP: Al (52), M (22, 28).
Substrate.-*Ulex parviflorus, Quercus rotundifolia, Fraxinus angustifolia, Lavandula stoechas, Crataegus monogyna.*
Herbaria.- MUB, H.JCh.-GM.

GLONIOPSIS De Not., Giorn. Bot. Ital. 2(2): 23. 1847
Typus. -Gloniopsis decipiens De Not. = G. praelonga (Schwein.) H. Zogg

Gloniopsis curvata (Fr.: Fr.) Sacc., Syll. Fung. 2: 775. 1883

≡ *Hysterium curvatum* Fr.: Fr., Elench. fung. 2: 138. 1828.
Typus. -In UPS (Herb. Fries). Rosa canina, leg. Mougeot. (ZOGG 1962: 54).

= *Gloniopsis decipiens* var. *cisti* Rehm, Hedwigia 25: 149. 1886

= *Hysterium smilacis* Schwein.: Fr., Syst. mycol. 2: 586. 1823
Ind. Loc. -Ad emortuos ramos Smilacis rotundifoliae. Carolinae (v. s.).
Gloniopsis smilacis (Schwein.: Fr.) Underw. & Earle, Alabama Agric. Exp. Sta. Progr. Rep. Ser. 80: 196. 1897

Chorology.- ESP: Mu (47,48). PRT: BL (79), E (19,36,83).
Substrate.- *Periploca laevigata, Smilax aspera, Smilax mauritanica, Lonicera etrusca, Cistus sp.*
Herbaria.- MHG, LISE.

Gloniopsis praelonga (Schwein.) H. Zogg, Beitr. Kryptogamenfl. Schweiz 11(3): 50. 1962
Typus. - In UPS (isotype Gloniopsis decipiens).

Italy, Genova, ex Herb. J. de Notaris in Herb. Fries

≡ *Hysterium praelongum* Schwein., Syn. Amer. bor. n.: 2074. 1834
Typus. -In PH (Schweinitz Herbarium). USA, Carolina, Pennsylvania. In ligno carioso. (isotype at the British Museum and at Kew (BISBY, 1932:318).

= *Gloniopsis decipiens* De Not., Giorn. Bot. Ital. 2: 23. 1847

= *Gloniopsis eucalypti* Costa & Sousa da Câmara, Portugaliae Acta Biol, Sér. B, Sist. 4(3/4): 332. 1954
Ind. Loc. - In LISVA. Portugal, Figueira da Foz, Serra da Boa Viagem, in caulibus Eucalypti sp., leg. Prof. Garcia Cabral, june 1953.

= *Gloniopsis levantica* Rehm, Hedwigia 25: 142. 1886

= *Hysterium mülleri* Duby, Mém. Soc. Phys. Genève 16: 32. 1862
Gloniopsis mülleri (Duby) Sacc., Syll. Fung. 2: 774. 1883

= *Hysterographium insigne* Cooke & Harkn., Grevillea 14: 10. 1885
Gloniopsis insignis (Cooke & Harkn.) Berl. & Voglino, Syll. Fung. add. vol. I-IV: 270. 1886

Chorology.- ESP: B (74), Bi (4,5), C (55), Ge (74), H (8), Na (57,58), Vi (4). PRT: Ag (17), BL (30,78,83), E (11,25,32,34).
Substrate.- *Acacia sp., Arundo donax, Buxus sempervirens, Castanea sativa, Catalpa syringaefolia, Cistus salvifolius, Erica arborea, Eucalyptus globulus, Eucalyptus sp., Fagus sylvatica, Lavandula stoechas, Lonicera sp., Myrtus communis, Pinus pinaster, Pinus halepensis, Quercus robur, Rhamnus sp., Rubus fruticosus, Rubus sp., Rubus ulmifolius, Smilax*

aspera, *Ulex* sp., wood without identification.
Herbaria.- AH, DSL, LISE, LISVA, MUB.

Observations: This is a cosmopolitan species. The type of *G. eucalypti* Costa & Sousa da Câmara is close to this species; nevertheless, its spores are smaller (17-20 x 6-8 μm).

Gloniopsis sinuosa (Cooke) Sacc., Syll. Fung. 2:. 1883

≡ *Hysterium sinuosum* Cooke, Grevillea 9: 15. 1880
Ind. Loc. -New Zealand, on bleached wood.

Chorology.- PRT: E (19,35,61,83), Mi (16).
Substrate.- *Arbutus unedo, Rhododendron sp.*
Herbarium.- LISE

GLONIUM Mühlenb.: Fr., Syst. mycol. 2: 594. 1823
Typus. -Glonium stellatum Mühlenb.: Fr., Syst. mycol. 2: 595 (1823).

Glonium caucasicum (Rehm) H. Zogg, Beitr. Kryptogamenfl. Schweiz. 11(3): 67. 1962

≡ *Gloniella caucasica* Rehm, Monit. Jard. Bot. Tiflis 25: 12. 1912
Ind. Loc. -Russia? Abchazia, fauces Petskir, ad caules Rubi sp. 23-III-1912, leg. G. Woronow (ZOGG, 1962: 68).

Chorology.- ESP: Mu (52).
Substrate.- *Thymus hyemalis*.
Herbarium.- MUB.

Glonium graphicum (Fr.: Fr.) Duby, Mém. Soc. Phys. Genève 16: 47. 1862

≡ *Hysterium graphicum* Fr.: Fr., Syst. mycol. 2: 581. 1823

Typus. -In UPS (Herb. Fries) (ZOGG 1962: 70). Pini silvestris aut. -vere (v. v.).

Chorology.- ESP: Ma (54).
Substrate.- *Pinus sp.*
Herbarium.- JL.

Glonium lineare (Fr.: Fr.) De Not., Giorn. Bot. Ital. 2: 27-28. 1847

≡ *Hysterium lineare* Fr.: Fr., Syst. mycol. 2: 583. 1823
Typus. -In Herb. Neuenburg (Scler. suec. n. 90) (ZOGG 1962: 64). Ad ligna Pyri Mali, Aceris Platanoidis & c. frequens. Perenne.

Chorology.- ESP: M (27), Mll (50,76), Na (40,41), T (76).
Substrate.- *Buxus balearica, Olea europea, Quercus rotundifolia, Salix sp.*
Herbaria.- H.JCh.-GM, BCC-DSL.

Glonium pusillum H. Zogg, Beitr. Kryptogamenfl. Schweiz 11(3): 62. 1962

Chorology.- PRT: E (25).
Substrate.- *Pinus pinea.*
Herbarium.- AH.

HYSTERIUM Tode: Fr., Syst. mycol. 2: 579. 1823
Typus.- Hysterium pulicare Pers.: Fr.

Hysterium acuminatum Fr.: Fr., Syst. mycol. 2: 582. 1823
Ind. Loc. -Ad lignum vetustum Fagi.

≡ *Hysterium acuminatum* var. *alpinum* Rehm. cf. 1896

= *Gloniella ambigua* P. Karst., Acta Soc. Fauna Fl. -Fenn. 18:. 1891

= *Hysterium ambiguum* Duby, Mém. Soc. Phys. Genève 16: 27. 1862

= *Hysterium angustatum* Alb. & Schwein., Consp. Fung. Lusat.: 55. 1805

= *Hysterium angustatum* var. *ceratoniae* Rolland, Bull. Soc. Mycol. France 21(1): 29. 1905

= *Hysterium rosmarini* Dias & Sousa da Câmara, Agron. Lusit. 14(2): 106. 1952
Typus. -In LISE (39090). Portugal, Estremadura, Serra da Arrábida, in ramulis Rosmarini officinalis L., 1951 Octobri 19, M.T. Lucas.

Chorology.- ESP:Ab (52), Al (52), B (74), Bi (5), Ca (54), Ge (74), Gu (28), M (42,83), Mll (64,70), Mn (64), T (7,74,76). Without locality (39). PRT: Ag (14, 18), BL (68,72,83), E (17,25,33,60,66), TM (46,83).
Substrate.- Acer pseudoplatanus, Aesculus hippocastanum, Arbutus unedo, Calycotome spinosa, Ceratonia siliqua, Cistus ladanifer, Cistus sp., *Erica arborea, Erica multiflora, Fagus sylvatica, Juniperus sabina, Juniperus thurifera, Lavandula stoechas (?), Myrtus communis, Olea europea, Ononis sp., Pinus halepensis, Pinus pinea, Pinus sylvestris, Pistacia lentiscus, Quercus cerrioides, Quercus ilex, Quercus ilex ssp. rotundifolia, Rhamnus alaternus, Rhododendron sp., Rosmarinus officinalis, Rubus fruticosus, Rubus ulmifolius, Ulmus sp., Vitis vinifera*, on unidentified dead wood.
Herbaria.- AH, HJCh.-GM, BCC-DSL, DSL, JL, I.Melo, LISE, MUB.

Observations: ZOGG (1962) considered *H. rosmarini* Dias & Sousa da Câmara as a synonym of *H. pulicare* Pers.:Fr., however the spores are 18-20 x 6-7,5 μm, uniformely brown and 3-septate, without constriction. I believe that these characters brings *H. rosmarini* Dias & Sousa da Câmara close to *H. acuminatum* and should be considered as a synonym of the latter.

Hysterium insidens Schwein., Trans. Amer. Philos. Soc. 2, 4: 244. 1832
Typus. -In BPI (Ex Herb. Schweinitz in Collins set). USA, Philadelphia, Bethlehem.

= *Hysterium berengerii* Sacc., Hedwigia 17:. 1878

= *Hysterium lavandulae* Urries, Anales Jard. Bot. Madrid 1: 64. 1941

Chorology.- ESP: Ge (74), J (52), M (83,85). PRT: BL (13,83,88).
Substrate.- *Pinus uncinata, Pinus pinaster, Lavandula stoechas var. pedunculata, Olea europea.*
Herbaria.- BCC-DSL, MA-Fungi, MUB.

Hysterium pulicare Pers.: Fr., Syst. Mycol. 2: 579. 1823
Typus. -In Herb. Neuenburg (Scler. suec. n. 61, 91 and 92) (Zogg 1962: 23).
Ad cortices & ligna, Quercus, Alni, Betulae & c. copiose (v. v.).
(British Museum, BISBY, 1932:318).

Chorology.- ESP: B (74), Ca (29,83), Ge (74), M (10,44,83), Mu (52), Na (1,6,40,51). PRT: BAl (66), BL (6879,83), E (17,65,80), Mi (11,46,83). Without locality (69).
Substrate.- *Castanea sativa, Cistus albidus, Cupressus sempervirens, Erica multiflora, Fraxinus excelsior, Liriodendron tulipifera, Olea europea, Pinus halepensis, Quercus cerrioides, Quercus ilex, Quercus robur, Rubus ulmifolius, Tilia platyphylla, Vitis vinifera,* on unidentified decayed bark on wood.
Herbaria.- DSL, MUB.

HYSTEROGRAPHIUM Corda emend. De Not., Giorn. Bot. Ital. 2(2): 21. 1847
Typus. -Hysterographium fraxini (Pers.: Fr.) De Not.

Hysterographium flexuosum (Schwein.: Fr.) Sacc., Syll. Fung. 2: 781. 1883

≡ *Hysterium flexuosum* Schwein.: Fr., Syst. mycol. 2: 585. 1823
Ind. Loc. -Ad ramos juniores Prunorum & Quercuum. Carolinae.

Chorology.- ESP: Gu (23), M (22,23), Sg (23).
Substrate.- *Corylus avellana, Fagus sylvatica, Quercus pyrenaica, Salix sp.*
Herbaria.- AH, H.JCh.-GM.

Hysterographium fraxini (Pers.: Fr.) De Not., Giorn. Bot. Ital. 2(2): 22. 1847

≡ *Hysterium fraxini* Pers.: Fr., Syst. mycol. 2: 585. 1823
Ind. Loc. -Ad ramos exsiccatos Fraxini, hieme, vere.
Hysterographium fraxini var. *oleastri* Desm., Ann. Sci. Nat., Bot., ser. 3, 22: 16. 1853

Chorology.- ESP: Ab (49), Ge (74), Hu (24,56), M (2,22,27,29,38,42,83,84), Ma, (53), Mll (50,70), Na (40,51), Sg (26). Without locality ((1). PRT: Ag (14), BL (68,72,78,84), DL (31), E (11,12,13,19,21,32,66,73,83), R (14). Without locality (13,19,83).
Substrate.- *Betula celtiberica, Corylus avellana, Fagus sylvatica, Fraxinus angustifolia, Fraxinus excelsior, Fraxinus sp., Phyllirea angustifolia, Olea europea, Olea europea var. sylvestris, Rhamnus oleoides, Salix sp.* on unidentified bark and wood.
Herbarium.- AH, HJCh.-GM, DSL, JL, MA-Fungi.

Hysterographium mori (Schwein.) Rehm, Ber. Naturhist. Vereins Augsburg 26: 76. 1881

≡ *Hysterium mori* Schwein., Syn. Amer. bor. n.: 2087. 1834
Typus. -In PH (Schweinitz Herbarium). USA, Philadelphia, Bethlehem, 1826. In lignis Mori

= *Hysterium grammodes* De Not., Giorn. Bot. Ital. 2: 29. 1847
Hysterographium grammodes (De Not.) Sacc., Atti. Soc. Veneto-Trentino Sci. Nat. Padova 2: 1279. 1873
= *Hysterium vulgare* De Not., Giorn. Bot. ital. 2: 18. 1847

Chorology.- ESP: B (9,74), Mu (52), O (81), Se (43,83), SS (82,83). PRT: BL (13,77,83), E (25,33,60,62,65,69).
Substrate.- *Asparagus albus, Callistemon sp., Chamaerops humilis, Olea europea, Pistacia lentiscus, Populus nigra, Populus sp., Prunus cerasiferus, Quercus robur, Salvia grahami, Spiraea sp., Ulex parviflorus*, madera sin identificar.
Herbaria.- AH, DSL, Ma-Fungi, MUB.

DOUDBTFUL AND EXCLUDED TAXA

? = doubtful taxa
= excluded taxa

? **Gloniella holoschoeni** (De Not.) Rehm, Syll. Fung. 9: 1115. 1891

Chorology.- ESP: B (45,83).
Substrate.- *Scirpus holoschoenus*.

? **Gloniella microtheca** Sacc. & Speg., Syll. Fung. 2: 768. 1883
Ind. Loc. -In culmis induratis Arundinis Donacis

vites sustinentibus, Conegliano Ital. bor. et in Gallia meridionali.

Chorology.- PRT: BL (71).
Substrate.- *Arundo donax*.

? **Gloniella sampaioi** Gonz. Frag., Bol. Soc. Brot., Sér. 2, 2: 34. 1923
Typus. -In MA-Fungi (5444). Portugal, circa Coimbra, in cortice Fici caricae, I-1916, Sampaio.

Chorologia.- PRT: BL (46).
Substrate.- *Ficus carica*.
Herbarium.- MA-Fungi.

Observations: The material corresponding to the type does not include any hysteriaceous fungi.

# **Gloniopsis pulla** De Not., Giorn. Bot. Ital. 2: 24. 1847

Chorology.- PRT: E (11,34).
Substrate.- *Erica arborea, Smilax aspera*.
Herbarium.- LISE

Observations: These specimens cited as *Gl. pulla* are *Gloniopsis praelonga* (Schwein.) H.Zogg. The material recorded on *Erica arborea* mainly corresponds to *Hysterium acuminatum* Fr.:Fr.

# **Gloniopsis stictoidea** (Cooke & Ellis) Sacc., Syll. Fung.,. 1883
= *Hysterium stictoideum* Cooke & Ellis, Grevillea 7: 7. 1878

Chorologia.- PRT: E (17).
Substrate.- *Prunus lauro-cerasi*

? **Glonium emergens** (Fr.: Fr.) Duby, Mém. Soc. Phys. Genève 16: 36. 1862

≡ Hysterium emergens Fr.: Fr., Elench. fung. 2: 140. 1828

Chorology.- ESP: Ab (48).
Substrate.- Dead wood without identification.
Herbarium.- MHG

Observations: This species is doubtful. ZOGG (1962) indicates that the type lacks hysterothecia. The spanish material (HONRUBIA & al., 1982) has been lost from the herbarium and consequently could not be studied. The description is close to *Glonium chambianum* Guyot, collected on *Lonicera* sp., from North Africa.

# **Glonium striola** (Fr.: Fr.) P. Karst., Acta Soc. Fauna Fl. -Fenn. 8:. 1871

≡ *Hysterium striola* Fr.: Fr., Elench. fung. 2: 145. 1828

Chorology.- ESP: Lo (90).
Substrate.- *Foeniculum vulgare*.

? **Glonium sp.**

Chorology: Mu (48).
Substrate: *Whithania frutescens*.
Herbarium: MHG

Observations: The authors (HONRUBIA & al., 1982) suggested that this material possibly represents *Glonium lineare* (Fr.:Fr.) De Not.; nevertheless, its spores are immature and it is not possible to decide to which genus it belongs. It could maybe represent *Gloniopsis praelonga* (Schwein.) H.Zogg.

# **Hysterium apiculatum** Corda

Chorology.- ESP: Hu (59,87).
Substrate.- *Festuca skia*

# **Hysterium arundinaceum** Schrad.

Chorology.- ESP: Lo (90).
Substrate.- *Arundo donax*

# **Hysterium commune** Fr.: Fr., Syst. mycol. 2: 589. 1823

Chorology.- ESP: Whitout locality (1,29).

# **Hysterium culmigenum** Fr.: Fr., Syst. mycol. 2: 591. 1823
Hysterium culmigenum var. *airarum* Fr.:Fr.

Chorology.- ESP: Z (1,59,87).
Substrate.- *Aira flexuosa*.

# **Hysterium cyperinum** Pers.

Chorology.- ESP: Lo (90).
Substrate.- *Cyperus badius*.

# **Hysterium labyrinthiforme** Ung.

Chorology.- ESP: Mll (66).

# **Hysterium opegraphoides** Pers.

Chorology.- ESP: Ge (86).
Substrate.- Branches.

# **Hysterium pinastri** Schrad.

Chorology.- ESP: M (1,2,29,59,87).
Substrate.- *Pinus sylvestris*.

# **Hysterium prostii** Duby, Mem. Tribu Hysterinées: 26. 1862

Chorology.- PRT: E (14).
Substrate.- *Crataegus monogyna*.

# **Hysterium rugosum** Fr.: Fr., Ell. fung. 2: 141. 1828
{} Hysterium rugosum var. faginea Fr.: Fr.

Chorology.- ESP: Ca (1,29).
Substrate.- cortezas sin identificar.

# **Hysterium scirpinum** Pers.

Chorology.- ESP: Lo (90).
Substrate.- *Scirpus maritimus, Scirpus holoschoenus.*

? **Hysterium sp.** López de Silanes & Carballal, Cryptog. Bryol. Lichénol. 8(4): 366. 1987

Chorology.- ESP: C (55).
Substrate.- *Quercus robur.*

# **Hysterium typhinum** Fr.: Fr., Syst. mycol. 2: 590. 1823

Chorology.- ESP: Lo (90).
Substrate.- *Typha angustifolia.*

# **Hysterium versisporum** W.R. Gerard, Bull. Torrey Bot. Club 4: 78. 1876
Ind. Loc. -U.S.A. on decorticated oak

Chorology.- PRT: Ag (14), E (60).
Substrate.- *Arbutus unedo.*
Herbarium.- LISE

Observations: These specimens represent *Hysterium acuminatum* Fr.:Fr.

? **Hysterographium sp.** Maire, Bull. Soc. Mycol. France 21(4): 215. 1905

Chorology.- ESP: PM (63).
Substrate.- *Buxus balearica*

Observations: There is no description in the paper above mentioned.

# **Hysterographium syringae** (Schwein.) Sacc., Syll. Fung. 2: 778. 1883

≡ *Hysterium syringae* Schwein., Syn. Amer. bor. n.: 2073. 1834
Typus. -In PH. (Schweinitz Herbarium). USA, Philadelphia, Bethlehem. In truncus Syringae. (isotype in Kew, BISBY, 1932:321)

Chorology.- ESP: Mll (64).
Substrate.- On dead branch.

Observations: ZOGG (1962) points that it may represent *Triblidium* sp.. On the other hand, MALENÇON & BERTAULT (1972) suggest it could be *Hysterographium* cf. *syringae*.

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REFERENCES

Almaraz, T. (1996). Bases corológicas de Flora Micológica Ibérica 693-894. Cuad. Trab. Fl. Micol. Ibér. 9:1-233.
Bisby, G.R. (1932). Type specimens of certain Hysteriales.Mycologia 24:304-329.
Bisby, G.R. & Hughes, S.I. (1952). Summary of the British Hysteriales. Trans. Br. Mycol. Soc. 35:308-314.
Cardoso,J. & Melo,I. (1992). Informaçao bibliográfica II. Portugal. Cuad. Trab. Fl. Micol. Ibér. 5:1-93
Honrubia, M., Bertault, R. & Llimona, X. (1982). Aportación al conocimiento de los hongos que fructifican en el S.E. de España. XIII. Plectomicetes . Loculoascomicetes. Pirenomicetes. Int. J. Mycol. Lichenol. 1(1):1-26.

Lado,C. (1993). Bases corológicas de Flora Micológica Ibérica 376-692. Cuad. Trab. Fl. Micol. Ibér. 7:1-305.

Malençon, G. & Bertault, R. (1972). Champignons de la Péninsule Ibérique.IV. Les Iles Baléares. Acta Phytotax. Barcinon. 11:1-64.

Pando,F. (1991). Manual de bases de datos de Flora Micológica Ibérica. Cuad. Trab. Fl. Micol. Ibér. 2:1-67.

Pando.F. (1996). Información bibliográfica III. España Peninsular e Islas Baleares. Cuad. Trab. Fl. Micol. Ibér. 8:326.

Pando,F., Dueñas,M., Lado,C. & Tellería,M.T. (1990). Información bibliográfica I. España Peninsular e Islas Baleares. Cuad. Trab. Fl. Micol. Ibér. 1:1-154.

Santamaría,S. (1996). Bases corológicas de Flora Micológica Ibérica 895-1113.Cuad. Trab. Fl. Micol. Ibér. 10:1-126.

Tellería,M.T. (1990). Annotated list of the Corticiaceae, sensu lato (Aphyllophorales, Basidiomycotina), for Peninsular Spain and Balearic Islands. Biblioth. Mycol. 135.

Tellería,M.T. (1991). Bases corológicas de Flora Micológica Ibérica 1-132. Cuad. Tr. Fl. Micol. Ibér. 3:1-188.

Tellería,M.T. (1992). Bases corológicas de Flora Micológica Ibérica 133-249. Cuad. Tr. Fl. Micol. Ibér. 4:1-208.

Tellería,M.T. (1993). Bases corológicas de Flora Micológica Ibérica 250-375. Cuad. Tr. Fl. Micol. Ibér. 6:1-180.

Zogg, H. (1962). Die Hysteriaceae s. str. und Lophiaceae. Beitr. Kryptogamenfl. Schweiz 11:1-190.

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ANILINE AGAR: A SIMPLE MEDIUM USEFUL IN CHARACTERIZING WHITE-ROT HIGHER FUNGI IN CULTURE

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Abstract: Species of fungi causing a white wood-rot comprise about 90 % of the wood-rotters. In the absence of a fruitbody it is possible, once isolated from the attacked wood, to determine the species responsible for the rot by using cultural features. We hereby propose a new test useful in fungal taxonomy which allows the separation of those fungi able to produce extracellular enzymes which react with aniline in an acid medium. The test consists in inoculating a small portion of mycelium in an acid aniline-containing medium. After 7 days it is possible to observe a brown halo around the inoculum in those species giving a positive reaction.

A screening test was carried out with 80 strains of species belonging to the orders Agaricales, Aphyllophorales and Auriculariales. All strains of Aphyllophorales causing brown-rot gave a negative reaction whereas two thirds of the test species causing white-rot gave positive results. The aniline test allows the separation, within the white-rotters, of those having extracellular enzymes capable of reacting with aniline. This test, added to the series of Nobles and Stalpers may be an additional useful element in taxonomy based on cultural characters.

INTRODUCTION

The study of axenic cultures of species of Hymenomycetes is useful in their taxonomic identification. It is possible, in the absence of a fruitbody, to determine the species causing wood-rot by isolating the fungus and studying its cultural features.

Chemical features of strains have been emphasized by Davidson et al. (1938), Nobles (1948), Boidin (1954) and Stalpers (1978), particularly regarding the presence or absence of extracellular enzymes. Other workers have proposed various tests for biochemical characterization in order to solve taxonomic problems. Marr (1979), using several phenolic compounds in spot-tests was able to demostrate the presence of laccase and tyrosinase in fruiting bodies of many different Basidiomycetes. These tests were later applied by Klan *et al.* (1989) as a feature in the cultural study of species of *Pholiota*. Hutchison (1990a, 1990b, 1992) employed physiological and biochemical features as important taxonomic characters of ectomycorrhizal fungi, such as the enzymatic degradation of selected carbon and nitrogen compounds, the extracellular deoxyribonuclease activity, the effect of standard extreme temperatures upon linear growth and diazonium blue B staining reaction of mycelia (Hutchison and Summerbell, 1990).

The tests used by Nobles (1938), Boidin (1954) and Stalpers (1978) consist of a series of qualitative reactions based on the breakdown of such compounds as gallic and tannic acids, tyrosine, guaiacol and p-cresol. These compounds are incorporated into a specific medium in Petri dishes, and the resulting agar is inoculated with the fungus to be tested, and then incubated in the dark at 25 °C for 7 days. Interpretation is made by observing the reaction: a coloured halo around the inoculum is considered positive. The extent of the reaction is given in function of the halo diameter and, in some cases, the colour intensity. Stalpers (*op. cit.*) on the other hand, used a spot test, which consists of placing a drop of reagent on growing mycelium. The reaction is read after 3 hours and again after 1 day. Intensity of the color reaction and the shape of the colored spot are important for reading the reaction.

At first, these reactions were applied mostly to wood-rotting members of the Aphyllophorales, mainly Polyporaceae and Corticiaceae (Nobles, 1948, 1965; Rajchenberg, 1983; Deschamps & Wright, 1975; Job, 1986). At present they are being applied also to other taxonomic groups such as the

Agaricales (Deneyer, 1960; Käärik, 1970; Galland, 1973; Jacobsson, 1989; Desjardin, 1990, among others).

Since known species causing a white-rot constitute about 90 % of the total of wood-rotting fungi (Gilbertson & Ryvarden, 1986), we propose an additional test useful for the taxonomy of such species. It enables separation of white-rotting fungi based on the capacity of the fungus to produce an extracellular enzymatic complex related to the degradation of aniline and possible aniline chemical derivatives in an acid medium. Tests were undertaken with 80 fungal strains involving 58 species belonging to the orders Aphyllophorales, Agaricales and Auriculariales.

MATERIALS AND METHODS

Aniline medium:

Solution A: 20 ml aniline (Mallinckrodt, high purity), 5 ml nitric acid (Merck), 500 ml distilled water.

Solution B: 20 g Difco Bacto-agar; 500 ml distilled water.

Solutions were sterilized separately at 120 °C for 20 minutes, cooled to 60 °C and mixed. Fifteen ml were dispersed per Petri dish (a quarter of its volume). The medium takes up to 3 hours to solidify due to the low pH (near 4). It is recommended to use the medium soon after preparation since it slowly darkens and may eventually blurr a correct reading of the reaction.

Inoculation:

For the screening, 80 strains from the culture collection of the Department of Biological Sciences, School of Exact and Natural Science, University of Buenos Aires (BAFC) were used (see next page). Strains were inoculated in Petri dishes containing ME: malt extract agar (12.5 g Difco-Malt extract, 20 g Difco-Bacto agar and 1000 ml distilled water. After 15 days of incubation at 25 °C, an agar cylinder of 5 mm diameter, taken from the growing margin, was inoculated in the dishes with the aniline medium, in duplicate. Each dish was inoculated with two agar cylinders spaced 4,5 cm apart (Fig.1). Dishes were then placed in an incubator in the dark at 25 °C. for 7 days; the reaction was read at the end of this period; it is best achieved by holding the dish against the light.

We also tested species of the genera *Agaricus* and *Ganoderma* which were grown in WA: water agar (20 g Difco-Bacto agar and 1000 ml distilled water) to verify if the result of the aniline test is independent of the mycelium which was later used for inocula was grown.

Those species whose rot type was ambiguous, were grown on tannic and gallic acid media. Concerning the Agaricales tested, these reactions were carried out only on those growing on wood.

Interpretation:

The reaction is considered positive when a brown halo varying in color from Pl.13 A1 to Pl.8 C5 (Maerz and Paul, 1930). is observed around the inoculum. In some tests it is possible to observe a dark halo surrounded by a lighter one. In these cases the diameter is taken as the total diameter of both halos. The halo may exhibit different diameters and it is coded as follows:

0 = negative.
+ = very weak; up to 5 mm.
++ = weak; 5-10 mm.
+++ = strong; 10-20 mm.
++++ = very strong; over 20 mm.

Strains used in the test.

Aphylloporales

Antrodia malicola: USA, Pennsylvania, State College, leg. L. O. Overholts & L. L. Sluzalis, 8-X-32 (strain 2674). Isol. & Det. no information. FP 56.437.

Antrodiella semisupina: NEW ZEALAND, Auckland, Waitemata, Waitakere Ranges, leg M. Rajchenberg (strain 0454). Isol. & Det. M. Rajchenberg.

Australoporus tasmanicus: NEW ZEALAND, Westland, Mt. Aspiring Nat'l Park, Haast Pass, Roaring Billy Forest Walk, leg. M. Rajchenberg, 8-V-89 (strain 0582). Isol. & Det. M. Rajchenberg.

Bjerkandera adusta: ARG., Tucumán, Horco Molle, leg. D. Job & A. Hdlaki, 11-IV-87 (strain 0130). Isol. D. Job, Det. M. Rajchenberg.

Ceriporiopsis cfr. *rivulosa*: CHILE, Osorno, P. N. Puyehuen, Las termas, leg. M. Rajchenberg, 15-IV-88 (strain 0711). Isol. & Det. M. Rajchenberg. BAFC 31.280.

Coriolopsis aspera: INDIA, W. Bengal, Dum dum, leg. A.Roy, 22-VI-82 (strain 0761). Isol. & Det. J. E. Wright & M. Rajchenberg, BAFC 34.261.

Coriolus versicolor f. antarcticus: ARG., Neuquén, Lago Filo Hua-Hum, leg. S. Seco, II-75 (strain 0266). Isol. & Det. J. Deschamps. BAFC 25.431.

Datronia mollis: ARG., Tucumán, Horco Molle, leg. D. Job, 9-IV-87 (strain 0451). Isol. D. Job, Det. M. Rajchenberg. BAFC 31.179.

Ganoderma applanatum s. lato*:* ARG., Buenos Aires, Llavallol, Santa Catalina, leg. O. Popoff, J. E. Wright & V. Suárez, 5-V-93 (strain 0677), Isol. & Det. A. Gottlieb, BAFC 33.094; Ibid., leg. E. Albertó, 29-V-93 (strain 2747) Isol. & Det. A. Gottlieb, BAFC 32.214; Buenos Aires, 25 de Mayo, leg. H. Hadges, 12-X-78 (strain 0728), Isol. & Det. J. E. Wright, BAFC 33.365; Avellaneda, Leg. M. Pose, 24-IV-93 (strain 2105), Isol. & Det. A. Gottlieb BAFC 33.082; Neuquén, Nat'l Park Lanín, Lo. Loloy, leg. P. Wielong & M. Rajchenberg, 13-IV-92 (strain 2563), Isol. & Det. M. Rajchenberg, BAFC 33.056.

Ganoderma resinaceum s. lato*:* ARG., Entre Ríos, Concordia, Parque Rivadavia, leg. J. Deschamps, 31-XII-71 (strain 0113), Isol. & Det. J. Deschamps, BAFC 24.434; Rosario, Tala, Palacio San José, leg. J. Deschamps, 29-XII-71 (strain 0228), BAFC 24.435; Gualeguay, leg. J. E. Wright 7-I-51 (strain 1009), Isol. C. Iaconis Det. J. E. Wright, BAFC 24.438; Buenos Aires, Martínez, leg. J. E. Wright, 23-III-69 (strain 0301), Isol. E. del Busto, Det. J. E. Wright, BAFC 24.417; Cap. Fed, Botanical Garden, leg. M. A. Argullo, 27-IV-78 (strain 0658), Isol. by E. del Busto Det. no information, BAFC 24.412.

Gloeophyllum saepiarium: ARG., Buenos Aires, Acassuso, leg. A. Zapater, 3-VII-49 (strain 0432). Isol. & Det. J. E. Wright.

Gloeophyllum striatum: ARG., Misiones, leg. Rivarola y Soto, I-64 (strain 0116), Isol. C. Iaconis, Det J. E. Wright & J. Deschamps.

Gloeoporus dichrous: ARG., Buenos Aires, Ramallo, leg. J. Deschamps, 22-II-75 (strain 0102). Isol. & Det. J. Deschamps, BAFC 23.864.

Heteroporus biennis: ARG., Buenos Aires, Llavallol, Santa Catalina, leg. H. H. Wyssling, 14-IV-67 (strain 0074), Isol. by N. Jaroslavsky, Det. J. E. Wright.

Hymenochaete pinnatifida: USA, Stoneville, Mississippi, leg. L. Lentz, 14-X-55 (strain 0092). Isol. & Det. L. Lentzn & D. Job, BAFC 34.263.

Irpex lacteus: ARG., Tucumán, San Miguel de Tucumán, leg. J. E. Wright, 9-VI-83 (strain 2598). Isol.: no information, Det.: M. Rajchenberg, 29.981.

Junghuhnia microspora: ARG., Misiones, Iguazú Nat'l Park, leg. M. Rajchenberg, 4-III-82 (strain 0814). Isol. & Det.: M. Rajchenberg, BAFC 27.995.

Laetiporus sulphureus: ARG., Buenos Aires, Llavallol, Santa Catalina, leg. J. Deschamps, 21-III-71 (strain 0205), Isol. & Det.: J. E. Deschamps, BAFC 23.326.

Microporellus obovatus: PARAGUAY, Concepción, Pto. Fonciere, leg. M. Rajchenberg, 23-II-90 (strain 0314). Isol. & Det.: M. Rajchenberg.

Oxyporus latemarginatus: ARG., Entre Rios, La Calera, Palmar de Colón, leg. E. del Busto & J. Deschamps, 11-IV-71 (strain 0444). Isol.: J. Deschamps, Det.: no information, BAFC 28.076.

Perenniporia martii: ARG., Misiones, Iguazú Nat'l Park, leg. J. E. Wright, 9-IX-92 (strain 2139). Isol. & Det.: J. E. Wright, BAFC 32.891.

Phaeolus schweinitzii: ARG., Buenos Aires, Ing. Maschwitz, leg. D. Cabral, 2-V-92 (strain 2237). Isol.: M. Bolontrade, Det. J. E. Wright, BAFC 32.757.

Phanerochaete chrysosporium: strain 0232 (= ATCC 34.541).

Phellinus &inopatagonicus: ARG., Chubut, Tehuelches, Wintter lake, leg. M. Rajchenberg, 12-II-91 (strain 2298). Isol. & Det.: M. Rajchenberg.

Phelinus gilvus var. *licnoides:* ARG., Misiones, Santa Ana, leg. C. Ibañez, 19-VII-91 (strain 2124). Isol. & Det.: C. Ibañez.

Postia caesius: ARG., Buenos Aires, La Plata, Punta Lara, leg. J. Deschamps & Vicari, 1-VII-72 (strain 0494). Isol. & Det.: J. Deschamps, BAFC 22.881.

Pyrofomes lateritius: ARG., Misiones, Iguazú Nat'l Park, leg. J. E. Wright., 8-IX-92 (strain 2153). Isol. & Det.: J. E. Wright, BAFC 33.072.

Ryvardenia campyla: ARG., Chubut, Los Alerces Nat'l Park, leg. M. Rajchenberg, 28-III-92 (strain 2551). Isol. & Det.: M. Rajchenberg.

Ryvardenia cretacea: ARG., Chubut, Tehuelches, Co. El Triana, leg. M. Rajchenberg & P. Cwielong, 15-IV-91 (strain 2286). Isol. & Det.: M. Rajchenberg.

Schizopora paradoxa: ARG., Tierra del Fuego, Ushuaia, Est. Moat, leg. M. Rajchenberg, 26-II-88 (strain 0571). Isol. & Det.: M. Rajchenberg, BAFC 34.264.

Skeletocutis australis: ARG., Río Negro, Nahuel Huapi Nat'l Park, Pto. Bless, road to Los Cantaros, leg. M. Rajchenberg, 16-III-87 (strain 2098). Isol. & Det.: M. Rajchenberg, BAFC 31.011.

Spongipellis fissilis: ARG., Buenos Aires, Castelar, INTA Castelar, leg. J. E. Wright, 5-II-70 (strain 0170) Isol.: I. Mohadeb, Det. J. Deschamps, BAFC 32.839.

Trametes trogii: ARG., Buenos Aires, Avellaneda, leg. M. Bolontrade, 18-III-91 (strain 0619). Isol.: M. Bolontrade, Det. J. E. Wright.

Trichaptum sector: ARG., Tucumán, Horco Molle, leg. D. Job & A. Hdlaki, 11-IV-87 (strain 0054). Isol.: D. Job, Det.: M. Rajchenberg.

Agaricales

Agaricus bisporus: SWISTZERLAND, Gossau, leg. Gariboldi, V-91 (strain 0206). Isol. from commercial specimens by Gariboldi.

Agaricus campestris: ARG., Buenos Aires, Villa Elisa, 23-IV-92, leg. E. Albertó (strain 0548). Isol & Det. E. Albertó.

Agaricus fiardii: ARG., Salta, Salta City, leg. A.Carattoni, 5-XII-91 (strain 2608) Isol. & Det.: E.Albertó, BAFC 32.593.

Agaricus aff. maskae: ARG., Buenos Aires, Moreno,leg. L. del Busto, 19-II-93 (strain 0577), Isol & Det. E. Albertó, BAFC 33.036.

Agaricus nivescens:, ARG., Buenos Aires, La Lucila, leg. J. E. Wright, 12-XII-90 (strain 0325), Isol. & Det. E. Albertó, BAFC 32.502; Ibid., Burzaco, Leg. E. Albertó, 4-XI-92 (strain 0555) Isol. & Det. E. Albertó, BAFC 33.009; Ibid., Derqui, leg. D. Cabral, 31-X-92 (strain 0557), Isol. & Det. E. Albertó, BAFC 32.920; Capital Federal, leg. Capelli, 4-XI-92 (strain 0566), Isol. & Det. E. Albertó, BAFC 32.921; Ibid. leg. S. Lopez, 16-XI-92 (strain 0568), Isol. & Det. E. Albertó, BAFC 33.033; Ibid., Derqui, leg. D. Cabral, 15-III-91 (strain 2542), Isol. & Det. E. Albertó, BAFC 32.576; Ibid.,Ipse., 18-III-91 (strain 2578), Isol. & Det. E. Albertó, BAFC 32.578; Ibid., Ciudad Universitaria, leg. E. Fernnández, 18-XII-91 (strain 2586), Isol & Det. E. Albertó; Ibid., Villa Elisa, Leg. E. Albertó 9-XII-91 (strain 2601), Isol & Det. E. Albertó; Nuñez, Ciudad Universitaria, leg. E. Albertó, 11-XII-91 (strain 2602), Isol. & Det. E. Albertó, BAFC 32.594; Ibid., San Isidro, leg. M. Marcet, 13-XI-91 (strain 2607), Isol. & Det. E. Albertó, BAFC 32.591.

Agaricus pampeanus: ARG., Tierra del Fuego, Ushuaia, Pto. Harberton, leg. D. Cabral, 20-I-93 (strain 0592), Isol. D. Cabral, Det. E. Albertó, BAFC 33.039; Ibid, leg. S. Lopez, 24-I-93 (strain 0593), Isol. D. Cabral, Det. E. Albertó, BAFC 33.040, Ibid., Ipse., 1-II-93 (strain 0594), Isol. D.Cabral, Det. E. Albertó, BAFC 33.042.

Agaricus placomyces: strain 2638 (=CBS 387.79)

Agaricus pseudoargentinus: ARG., Cap. Fed., leg. D. Cabral, 02-V-91 (strain 0311), Isol. & Det.: E. Albertó, BAFC 32.334; Cap. Fed., leg. E. Albertó, 13-I-91 (strain 2605), Isol. & Det.: E. Albertó, BAFC 32.726.

Agaricus subperonatus: strain 2633 (= CBS 434.85)

Agaricus valdiviae: ARG., Cap. Fed., Ezeiza, leg. E. Albertó, 22-IV-91 (strain 2575), Isol. & Det.: E. Albertó, BAFC 32.577.

Agrocybe cylindrica: ARG., Buenos Aires, Cap. Fed, leg. Alumnos, 27-IV-94 (strain 2035). Isol. & Det.: E. Albertó. BAFC 33.382.

Bolbitius coprophilus: ARG., Cap. Fed. leg. E. Albertó, 29-IX-93, (strain 0372), Isol. & Det.: E. Albertó. BAFC 33.229.

Boletus edulis: ARG., Buenos Aires, Pinamar, Vivero, leg. J. Deschamps, 13-II-88 (strain 2246) Isol. & Det.: J. Deschamps.

Coprinus congregatus: FRANCE, Lyon, leg. G. Manachere, 19-X-71 (strain 0694), Isol.: G. Manachere, Det.: Bille-Hansen. BAFC 34.260.

Coprinus friesii: Buenos Aires, Martinez, Leg. J. E. Wright, 12-II-90 (strain 0061), Isol. & Det.: J. E. Wright. BAFC 34.259.

Gymnopilus chrysopellus: ARG., Buenos Aires, Llavallol, Santa Catalina, leg. E. Fernández & E. Albertó, 23-XI-93 (strain 0611). Isol. & Det.: E. Albertó & A. Fazio. BAFC 33.245.

Gymnopilus spectabilis: ARG., Buenos Aires, Ezeiza, leg. E. Albertó, 22-IV-91 (strain 2466). Isol. & Det.: E. Albertó. BAFC 32.321.

Lentinus edodes: CANADA, Vancouver, leg. Silvia Blumenfeld, X-1989 (strain 1318). Isol. from commercial specimens. Isol. & Det. Silvia Blumenfeld.

Lepista nuda: ARG., Buenos Aires, Olivos, leg. J. H. Hunziker, 18-V-91 (strain 0071). Isol. E. Albertó, Det. J. E. Wright. BAFC 32.317.

Pleurotus lindquistii: ARG., Buenos Aires, Parque Pereyra, leg. R. Singer, 2-VI-62 (strain 2102). Isol. J. E. Wright, Det. R. Singer.

Pleurotus ostreatus: ITALIA, leg. E. Albertó, IX-93 (strain 2067). Isol. from commercial specimens. Isol. & Det. E.Albertó.

Schizophyllum commune: ARG., Santiago del Estero, Santiago del Estero City, leg. no information, 11-VII-86 (strain 0201). Isol. & Det. no information.

Auriculariales

Auricularia fuscosuccinea: ARG., Tucumán, leg. A. P. Digilio, no date (strain 2033), Isol. & Det.: A. P. Digilio.

Auricularia polytricha: ARG., Misiones, leg. A. Offermann, III-62 (strain 2095), Isol. & Det.: R. T. Guerrero, BAFC 23.003.

RESULTS

Results are shown in Table I. From a total of 80 strains tested, 57 gave positive results. Among the Aphyllophorales, all brown-rot fungi and one third of the white-rot fungi gave a negative result. Of the Agaricales, positive results were obtained in 30 of the 36 strains tested. In all cases no growth of mycelium was observed after the incubation period. Figure 1 shows the difference in magnitude and intensity among six species tested; as illustrated the halos produced by the duplicates were always identical.

Table I: Result of the aniline test with different species of *Hymenomycetes*.

APHYLLOPORALES			
Species	Strain	Test	Rot
Antrodia malicola	2674	-	B
Antrodiella semisupina	0454	+++	W
Australoporus tasmanicus	0582	+++	W
Bjerkandera adusta	0130	-	W
Ceriporiopsis rivulosa	0711	-	W
Coriolopsis aspera	0761	-	W
Coriolus versicolor	0266	++++	W
Datronia mollis	0451	-	W
Ganoderma applanatum (Complex)	0677	+++	W
	0728	+++	W
	2105	+++	W
	2563	+++	W
	2747	+++	W
Ganoderma resinaceum (Complex)	0113	+++	W
	0228	+++	W
	0301	+++	W
	0658	+++	W
	1009	+++	W
Gloeophyllum sepiarium	0432	-	B
Gloeophyllum striatum	0116	-	B
Gloeoporus dichrous	0102	-	W
Heteroporus biennis	0074	++	W
Hymenochaete pinnatifida	0092	-	W

Strain: is the BAFC number; R= the intensity of the reaction; Rot= W: White rot; B: Brown rot; N/A, not applicable.

Table I (Continued): Result of the aniline test with different species of *Hymenomycetes*.

APHYLLOPORALES			
Species	Strain	Test	Rot
Irpex lacteus	2598	-	W
Junghuhnia microspora	0814	++++	W
Laetiporus sulphureus	0205	-	B
Microporellus obovatus	0314	++++	W
Oxyporus latemarginatus	0444	-	W
Perenniporia martii	2139	-	W
Phaeolus schweinitzii	2237	-	B
Phanerochaete chrysosporium	0232	-	W
Phellinus andinopatagonicus	2298	++	W
Phelinus gilvus	2124	+++	W
Pycnoporus sanguineus	0097	++++	W
Pyrofomes lateritius	2153	+++	W
Ryvardenia campyla	2551	-	B
Ryvardenia cretacea	2286	-	B
Schizopora paradoxa	0571	+++	W
Skeletocutis australis	2098	++++	W
Spongipellis fissilis	0170	++++	W
Trametes trogii	0619	++++	W
Trichaptum sector	0054	+++	W
AGARICALES			
Species	Strain	Test	Rot
Agaricus bisporus	0206	++++	N/A
Agaricus campestris	0548	+++	N/A
Agaricus fiardii	2608	++++	N/A
Agaricus aff. maskae	0577	++++	N/A
Agaricus nivescens	0325	+++	N/A
	0555	+++	N/A
	0557	+++	N/A
	0566	+++	N/A
	0568	+++	N/A
	2542	+++	N/A
	2578	+++	N/A
	2586	+++	N/A
	2601	+++	N/A

Agaricus nivescens	2602	+++	N/A
	2607	+++	N/A
	2736	+++	N/A
Agaricus pampeanus	0592	+++	N/A
	0593	++	N/A
	0594	+++	N/A
Agaricus placomyces	2638	++++	N/A
Agaricus pseudoargentinus	0311	+++	N/A
	2605	+++	N/A
Agaricus subperonatus	2636	+	N/A
Agaricus valdiviae	2575	+++	N/A
Agrocybe cylindrica	0151	-	B
Bolbitius coprophilus	0372	-	N/A
Boletus edulis	2246	-	N/A
Coprinus congregatus	0694	+	N/A
Coprinus friesii	0061	+	N/A
Gymnopilus chrysopellus	0611	-	B
Gymnopilus spectabilis	2466	-	B
Lentinus edodes	1318	+++	W
Lepista nuda	0071	+++	N/A
Pleurotus lindquistii	2102	++	W
Pleurotus ostreatus	2067	+	W
Schizophyllum commune	0201	-	W
AURICULARIALES			
Species	Strain	R	Rot
Auricularia fuscosuccinea	2033	-	W
Auricularia polytricha	2095	++	W

Strain: is the BAFC number; R= the intensity of the reaction; Rot= W: White rot; B: Brown rot; N/A, not applicable.

In those cases where several strains of the same species were tested (*Agaricus* and *Ganoderma* spp.), all gave similar, clear and distinct results, showing very little variation (see Table I).

No differences were observed between the results obtained with the aniline test when comparing species grown on

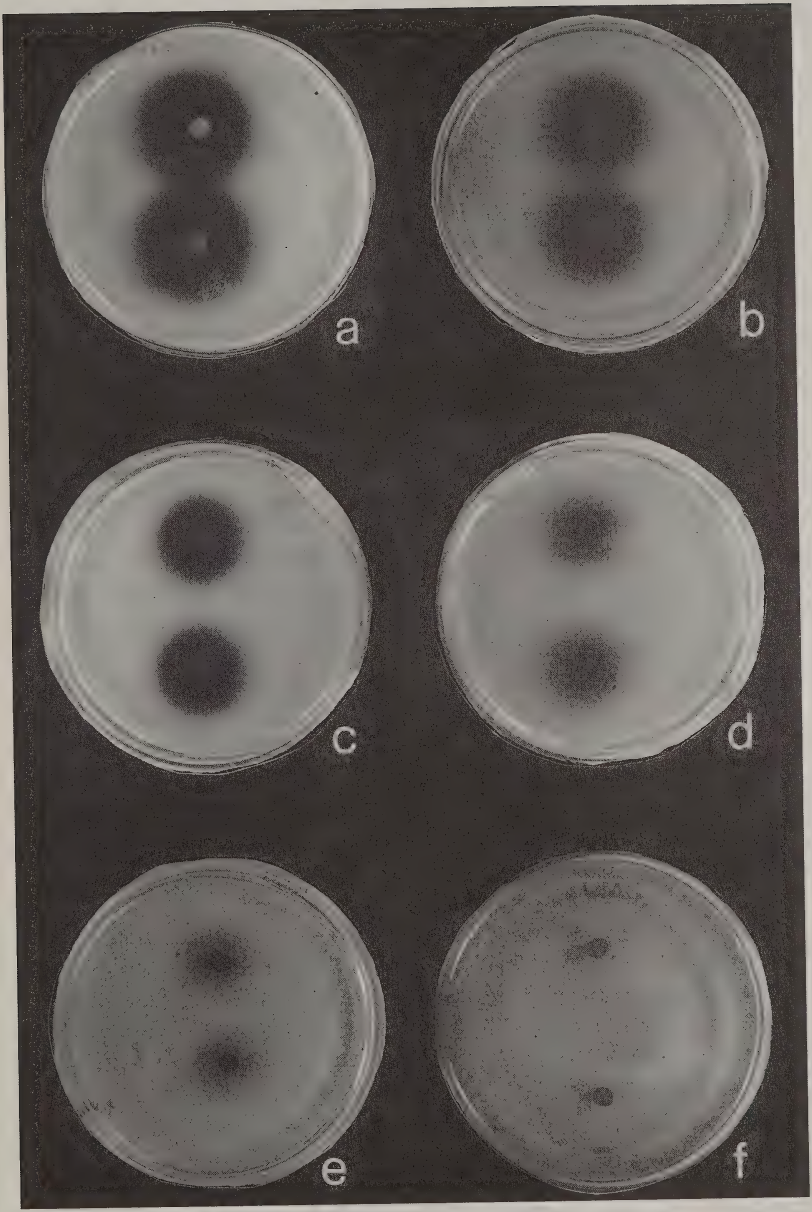

Fig. 1: Aniline reaction obtained in six fungal species. a) *Pycnoporus sanguineus*; b), *Microporellus obovatus, c) Skeletocutis australis*; d) *Trametes trogii*; e) *Ganoderma applanatum s. l.* and *f) Phanerochaete chrysosporium.*

ME and WA thus, troughtout the experiment we used ME which allows a faster growth of the strains tested.

DISCUSSION AND CONCLUSION

Recently Khan & Overend (1990), isolated an oxygenase system from *Trametes versicolor* that is capable of attacking lignin and a large number of di- and tri- substituted benzene rings. This non-selective enzyme operates at pH 3-5.

The action of the enzyme system that caused the transformation resulted in the production of CO_2 from a number of aromatic compounds (aniline, P-anisidine, catechol, p-cresol, guaiacol, lignin, syringic acid, etc). Aniline in an acid medium is more reactive, producing a series of polysubstituted aromatic compounds (Noller, 1966). We have verified that this reaction, associated with the aniline test, is enzymatic (probably aniline-oxidase). Positive results were also obtained by inoculating agar plugs of *Agaricus* species grown on water agar medium; consequently we could be dealing with a constitutive system not dependent on the medium.

The aniline test is not useful to distinguish between brown and white-rot Aphyllophorales since among the latter there are species also giving negative results, whereas brown-rot fungi are always negative. This test is useful only to separate species within white-rotting fungi.

In all the taxonomic groups tested we obtained positive and negative results. We invite other workers to use this test as a possible tool useful in the separation of white-rot fungi. If this test is found to be useful then it can be incorporated in the standard Nobles' and Stalpers' series of tests as an additional element in the study of fungal species in axenic culture

ACKNOWLEDGEMENTS

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LITERATURE

Boidin, J. , 1954. Essai biotaxonomique sur les Hydnés resupinés et les Corticiés. Rev. Mycol. Mem. hors. Ser. 6, 388 pp.

Davidson, R. W., W. A. Campbell and D. J. Blaisdell, 1938. Differentiation of Wood-Decaying Fungi by their reactions on gallic or tannic acid medium. J. Agric. Res. 57: 683-695.

Deneyer, W. B., 1960. Cultural studies on *Flammulina alnicola* (Fr.) Kummer and *Flammulina conissans* (Fr.) Gillet. Can. J. Bot. 55: 1167-1180.

Deschamps, J. & J. E. Wright, 1975. Clave para el reconocimiento en cultivo de las especies xilófagas de *Basidiomycetes argentinae*. Rev Inv. Agr. INTA. Serie 5, 12(2): 78-87.

Desjardin, D. E., 1990. Culture morphology of *Marasmius* species. Sydowia 42: 17-87.

Galland, M. C., 1973. Contribution a l'étude du genre *Psathyrella*. Étude des myceliums en culture pure. Applications du test d'interfertilité pour la delimitation des espèces critiques. Thése, 132 pp. Lyon.

Gilbertson, R. L. & L. Ryvarden, 1986. North American polypores. Vol. I, Fungiflora, Oslo, Norway, 433 pp.

Hutchison, L. J., 1990a. Studies on systematics of ectomycorrhizal fungi in axenic culture. II. The enzymatic degradation of selected carbon and nitrogen compounds. Can. J. Bot. 68: 1522-1530.

Hutchison, L. J., 1990b. Studies on systematics of ectomycorrhizal fungi in axenic culture. V. Linear growth response to standard extreme temperatures used as taxonomic character. Can. J. Bot. 68: 2179-2184.

Hutchison, L. J., 1992. The taxonomic significance of extracellular deoxyribonuclease activity among species of ectomycorrhizal fungi. Mycotaxon 45: 63-69.

Hutchison, L. J. and R. C. Summerbell, 1990. Studies on systematics of ectomycorrhizal fungi in axenic culture. Reactions of mycelia to diazonium blue B staining. Mycologia 82: 36-42.

Jacobsson, S., 1989. Studies on *Pholiota* in culture. Mycotaxon 36:1 95-145.

Job, D., 1986. Cultural and cytological studies in the genus *Hymenochaete* Lév. Mycotaxon 26: 223-234.

Käärik, A., 1970. The culture characters of some species of Agaricaceae. Ann. Social. Lithuanian 5: 112-123.

Khan, A. W. and R. P. Overend, 1990. An oxygenase enzyme system from *Trametes versicolor*. FEMS Microb. Lett. 66: 215-220.

Klan, J., D. Baudisova, and I. Rulfova, 1989. Cultural, enzymatic and cytological studies in the genus *Pholiota*. Mycotaxon 36: 249-271.

Maerz A. & M. Paul, 1930. Dictionary of color. Mc. Graw Hill Book Company, Inc. New York. 207 pp.

Marr. C. D., 1979. Laccase and tyrosinase oxidation of spot test reagents. Mycotaxon 9: 244-276.

Nobles, M. K., 1948. Studies in forest pathology VI. Identification of culture of wood-rooting fungi. Can. J. Res. 26: 281-413.

Nobles, M. K., 1965. Identification of cultures of wood-inhabiting Hymenomycetes. Can. J. Bot. 43: 1097-1139.

Noller, C. R., 1966. Chemistry of Organics Compounds. Saunders Co. London. 1319 pp.

Rajchenberg, M., 1983. Cultural studies of resupinate Polypores. Mycotaxon 17: 275-293.

Stalpers, J. A., 1978. Identification of wood-inhabiting Aphyllophorales in pure culture. Stud. Mycol. 16: 1-248.

MYCOTAXON

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A NEW SPECIES OF *RUSSULA* FROM KERALA, INDIA

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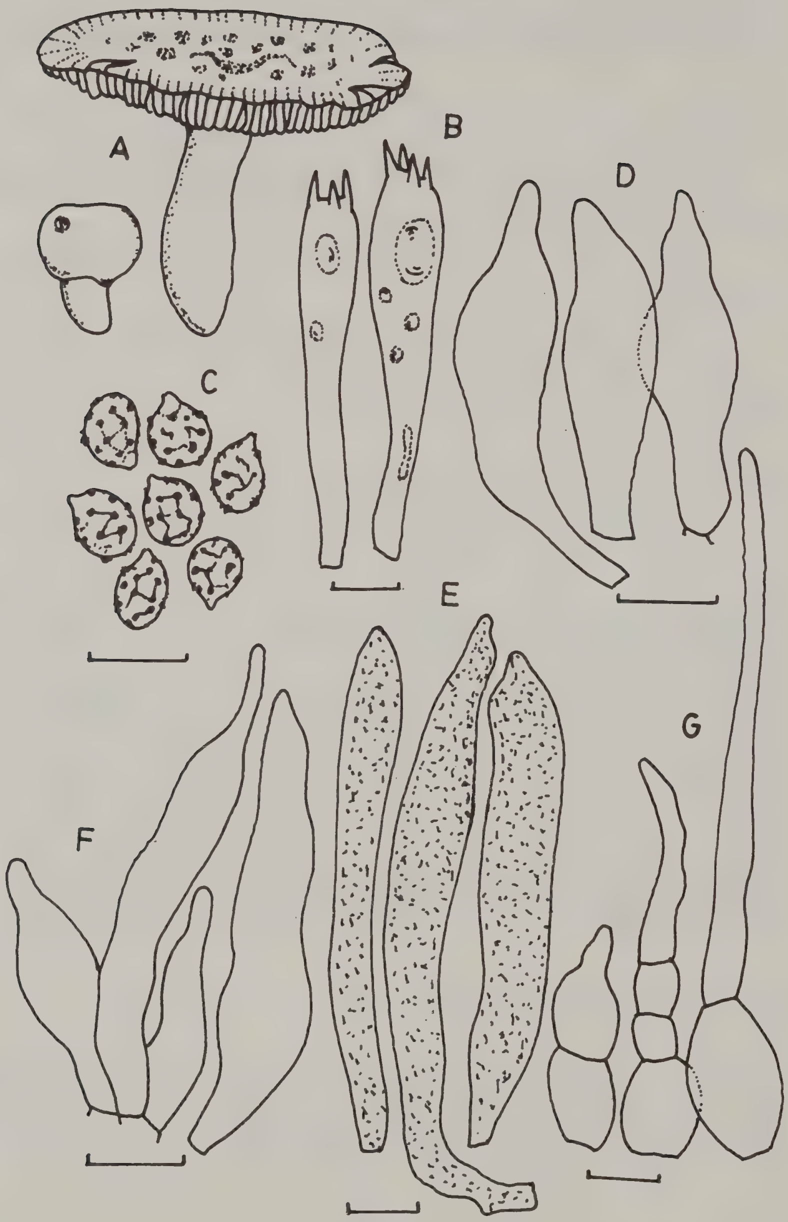
ABSTRACT

Russula leelavathyi sp.nov. is described based on collections from Kerala, south India.

During the course of investigation of the agaric flora of Western Ghats of Kerala, an interesting agaric was collected from the river banks of TBGRI campus. Critical microscopic observations revealed that the fungus is an undescribed species of the genus *Russula* Pers. Herein we describe the fungus and compare it with the some what similar species. The morphological characteristics were drawn from fresh materials. All sections were prepared in 3% KOH. Colour names in quotes are from Kornerup & Wanscher (1967). The materials cited are deposited in the Mycological Herbarium of the Microbiology Division, TBGRI, Kerala and part at Kew.

Russula leelavathyi sp. nov. Fig.1, A-G

Etymology : The species is named in honour of Dr.K.M.Leelavathy, Professor of Botany, Calicut University, Kerala, India, who inspired the senior author and many others to pursue careers in mycology.


A
B
C
D
E
F
G

Pileus 3-7 cm latus, carnosus, convexus deinde planus, fine dipressus in centro, superfacies leve flavis, levis et integer in disco, disrumpens in appressas squamas, sulcate-striatus in margine. Lamellae adnexae, albae, densae, saepe furcatae, lamellulae nullae. Stipes albus, cylindricus, glaber. Sporae albae in cumulo, subglobosae, reticulatae, macula suprahilaris inamyloidea. Basidia clavata, 4-sporigera. Acies lamellarum sterilis. Cheilocystidia hyalina, clavata, fusiformia ad lageniformia, obtusa vel mucronata. Macrocystidia abundantia.

Pileus 3 - 7 cm diam., fleshy, convex then expanded with a central depression; surface uniformly `ivory ' (4B3) in the primordial stage, sometimes darker, `corn' to `red-haired' (4B5-6C4), aerolately cracked forming patches of ivory squamules on a white ground, entire at the disk; margin radially plicato-sulcate for two-thirds of radius from the margin and cracking along radial striae to expose underlying white context below, gelatinized during rainy weather, the pellicle often gets completely washed away when exposed to heavy rains, the surface then appearing pure white and smooth. Lamellae adnexed, white, up to 5 mm wide, crowded, lacking lamellulae, occasionally furcate. Stipe 2-5 cm x 0.5-1.5 cm, central, cylindric, equal or more often slightly attenuated at the base, solid becoming stuffed; surface white, smooth. Annulus absent. Context white, up to 4 mm wide, heteromerous, with thin-walled, hyaline hyphae, 1.5-6 µm wide, intermixed with sphaerocytes, 16.5-25.5 µm diam. Odour not characteristic. Taste slightly acrid. Spore deposit white. Spores 6.5-7.5 x 5-6 µm, subglobose to broadly ovoid, hyaline with an ornamentation of coarse, amyloid, verrucae and scattered fine connectives forming a partial reticulum; suprahilar plage inamyloid. Basidia 36-55.5 x 9-12 µm, clavate bearing four sterigmata. Lamella-edge sterile, with abundant cheilocystidia, hardly reviving after drying. Cheilocystidia 19.5-34.5 x 6-10.5 µm, clavate fusoid, lageniform, often with acutely pointed or mucronate apex. Macrocystidia 10.5-64.5 x 7.5-10.5 µm ventricose, fusoid to

Fig. 1, A-G *Russula leelavathyi*. A. habit x 1; B. basidia; C. spores; D. cheilocystidia; E. macrocystidia; F. caulocystidia; G.epithelial elements.
Scale bar = 10 µm.

acuminate, thin-walled with granular contents, numerous both on sides and edges of the lamellae. Hymenophoral trama heteromerous, composed of thin-walled, hyaline hyphae, intermixed with sphaerocytes. Pileipellis distinctly two-layered, an upper epithelial layer composed of 2-4 subglobose to globose catenate elements, with their terminal elements cystidioid and a lower loosely interwoven, gelatinised zone of narrow hyphae. Stipitipellis with abundant caulocystidia, 22.5-40.5 x 7.5-13.5 µm, similar to cheilocystidia.

Solitary to scattered on sandy soil.

Specimens examined : India, Kerala : **TBGRI campus**; 17 Nov. 1994, **No.1990, (K, holotype)** ; 18 Oct.1993, No.25; 1 Nov.1993, No.176; 17 Nov.1993, No.372; 13 Dec.1993, No. 475; 21 Dec. 1993, No. 492; 23 Dec.1993, No.497; 18 April 1994, No. 597; 19 April 1994, No. 604; 22 April 1994 No. 650; 25 April 1994, No. 652; 31 May 1994, No.804; 4 June 1994, No. 865; **Agasthyamala**; 10 April 1994,No. 973; **TBGRI Campus**; 27 June 1994, No.991; 18 July 1994, No. 1099; 19 July 1994,No. 1110; 20 July 1994, No. 1117; 25 July 1995, No.1176; 28 July 1994, No. 1225; 5 Aug.1994, No. 1309; 8 Aug.1994,No. 1326; 13 Sept. 1994, No. 1547; 29 Sept. 1994, No. 1550; 25 Oct.1994, No. 1814; 28 Oct.1994, No. 1850; 31 Oct.1994, No. 1872; 3 Nov. 1994, No. 1884; 13 Nov. 1994, No.1947; 16 Nov. 1994, No.1976; 27 April 1995, No. 2084; 4 May 1995, No. 2134; 18 May 1995, No.2179; 15 June 1995, No. 2275; 17 June 1995, No. 2297; 20 June 1995, No. 2331; 23 June 1995, No. 2354; 30 June 1995, No. 2366; 3 July 1995, No. 2370; 20 July 1995, No. 2381; 10 Aug.1995, No. 2438; 22 Aug.1995, No. 2470; 24 Aug. 1995, No. 2475; 18 Sept. 1995, No. 2517; 19 Sept. 1995, No.2551; 4 Oct. 1995, No. 2555; 17 Oct. 1995, No. 2606; 26 Oct.1995, No. 2630; 20 Nov. 1995, No. 2751; 21 Nov. 1995, No.2760; 22 Nov. 1995, No. 2775.

This species is found growing in large numbers along the river side in sandy soil presumably having mycorrhizal association with *Hopea parviflora* Bedd. (Dipterocarpaceae). The furcate lamellae together with the lack of lamellulae, would indicate the species to belong in the section *Heterophylleae* Fr. emend. Romagn., and the epithelial pileipellis places the species within subsection *Pseudoepitheliosinae* Buyck.This subsection proposed by Buyck (1990), comprises pantropical species only, and this is the first record of a species from the Indian subcontinent. It most closely approaches *R.moyersoeni* Buyck, from Venezuela, in the overall habit and pigmentation but can be separated by virtue of the white pileus, smaller spores with a finer ornament, the lack of pileal macrocystidia and the presence of caulocystidia.

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REFERENCES

Buyck, B. (1990). New taxa of Tropical Russulae: *Pseudoepitheliosinae* subsect. nov. *Mycotaxon* 39:317-327.

Kornerup, A. & Wanscher, J.H. (1967). *Metheuen Handbook of Colour* 2nd edn. London : Methuen.

MYCOTAXON

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ON SOME INFREQUENTLY ENCOUNTERED FUNGI COLLECTED IN RHODE ISLAND, USA.

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Abstract

Six species of fungi which, according to existing distribution records, appear to be infrequent in northeastern United States are discussed. Brief notes on geographic distribution, morphology and systematics are given for each.

Key Words: *Camarops, Eversia, Hyalopycnis, Phaeocalicium, Pisolithus, Scleroderma.*

Biogeography of fungi is a topic of considerable biological interest, but mycologists are often limited by a lack of distribution records and information about specimens upon which these records are based. Fungal ecologists face a similar quandary. For that reason, information is presented concerning six species which, while present in the New England area, appear to have been collected infrequently in this region. Presentation of such information may encourage further collecting and lead to the expansion of biogeographic knowledge regarding these fungi. Specimens listed in this report, including one from the Snell Herbarium, have been deposited with the New York Botanical Garden Herbarium (NY).

1. ***Camarops petersii*** (Berk. & Curt.) Nannfeldt.

= *Peridoxylon petersii* (Berk. & Curt.) Shear

Camarops petersii (Fig. 1) is a common species in southern U.S. but appears to be rarely encountered in northern parts of the country. Fergus (1973) and Horn (1984) both commented on the rarity of this fungus in north temperate zones. Heagle and French (1972) found it on an oak log near St. Paul, Minnesota, and stated that their collection was the northern-most report of *C. petersii* in North America. They gave the distribution of the fungus within the U.S. as Alabama, Indiana, Kentucky, Ohio, and Virginia. Three additional states can now be added to this list, namely, Illinois (Horn, 1984), Pennsylvania (Fergus, 1973), and Rhode Island (this report). According to Horn (1984), the fungus is also known from Cuba and Korea. The Rhode Island collection sites are similar in north latitude to St. Paul, and fall within the known northern range of the fungus in the United States.

Identification of the Rhode Island material was based on the report of Hilber and Hilber (1980). Stroma of the Rhode Island specimens ranged from small (4 x 2.5 cm) to large 12 x 9.5^{-10} cm). Asci, each containing 8 linearly arranged ascospores, measured 50-55 x 5 μm in size. The ascospores measured 7-8 x 4-5 μm. These sizes are consistent with those given by Hilber and Hilber (1980) for this species.

Specimens examined: On large (1 m. diam.) dead, oak log, University of Rhode Island (URI) North Woods, Kingston, September 1980, coll. by Stephanie Digby, and September 24, 1981, coll. by R. Goos. On dead wood, Kimball Wildlife Preserve, Charlestown, September 21, 1991. Coll. by R. Goos.

2. *Eversia subopaca* (Cooke and Ellis) Crane & Schoknecht

=*Helminthosporium subopacum* Cooke. & Ellis

Schoknecht and Crane (1977) gave an updated description of this species and discussed its nomenclature and distribution. They cite specimens from the United States (New Jersey and West Virginia), Europe and Japan. Hawksworth *et al.* (1995) list its distribution as "widespread". A single collection of the fungus has been made in Rhode Island.

Specimen examined: On dead wood, Kimball Wildlife Preserve., Charlestown, September 21, 1991.

3. *Hyalopycnis blepharistoma* (Berk.) Seeler

Bandoni and Oberwinkler (1981) discussed this fungus, noting that while it is known from widely scattered localities, including Austria, England, North America (British Columbia, Louisiana, New York and Ontario) and Japan, it is infrequently reported. The fungus was isolated from a decaying mushroom collected in Rhode

Island during an attempt to isolate the more conspicuous genus, *Amblyosporium*. Culture characteristics were consistent with the descriptions given by Bandoni and Oberwinkler.

Material examined: Culture No. ATCC 90445 (RDG-496), isolated from a decaying mushroom, collected at the Alton Jones Campus, October, 1989.

4. *Phaeocalicium polyporaeum* (Nyl.) Tibell

Phaeocalicum polyporaeum, a lichenized discomycete, grows on old basidiomata of *Hirschioporus* (Fr.) Bond. & Sing. (Hutchison, 1987). Hutchison (1987) lists records from eastern Canada and northeastern United States, indicating that although the fungus is broadly distributed in our region, it is rarely encountered. The fungus was first brought to my attention by a student, and once I was made aware of the association with *H. paragamenus*, it has been found in our area several times.

Specimen examined: On *Hirschioporus paragamenus*, URI North Woods, April 1992. Coll. Alex Frost.

5. *Pisolithus tinctorius* (Pers.) Coker and Couch

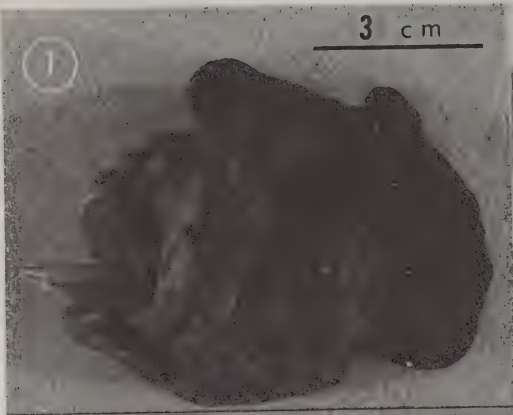
This species is a well-known ectomycorrhizal fungus with world-wide distribution. It appears to be infrequent or rare in northeastern U.S. Johnson (1974) commented that the fungus is rare in Ohio, although Coker and Couch (1974) considered it common in North Carolina. Smith (1951) stated that the fungus appears to be rare in the Great Lakes region, but common along road cuts in Washington and Oregon. I have collected it only once in Rhode Island (Fig. 2) in twenty-five years of collecting. A specimen from Massachusetts was found in the herbarium of the late Walter Snell, donated to the URI Botany Department.

Specimens examined: On soil, URI Campus, Kingston. August, 1966. Coll. R. Goos. On sandy bank, Plymouth, Massachusetts, October 10, 1950, Coll. James Rees (from the Walter Snell Herbarium).

6. *Scleroderma arenicola* Zeller

An unusual puffball with rhizomorph-like attachment strands (Fig. 3) was found on the beach sands in the fall of 1993. Macroscopically, the specimen resembles somewhat *S. polyrhizon* Pers. (=*Scleroderma geaster* Fr.), as illustrated by Miller and Miller (1988), but it is clearly not that species. The spores of the Rhode Island fungus are 12-18μm in diam. and bear distinctive reticulations on their outer surface (Fig. 4). Spore size is consistent with those given by Smith (1951) for *S. arenicola*, and other morphological features also agree with his description of these species.

Interestingly, Coker and Couch (1974) discussed two groups of fungi under the name *S. bovista* Fries, one of which they designated as *S. bovista sensu* Hollos, and the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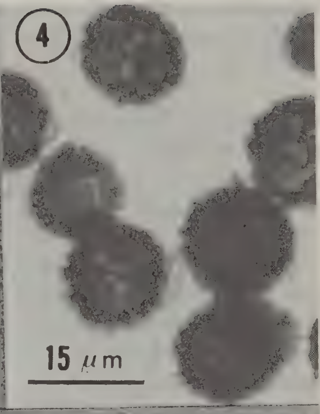
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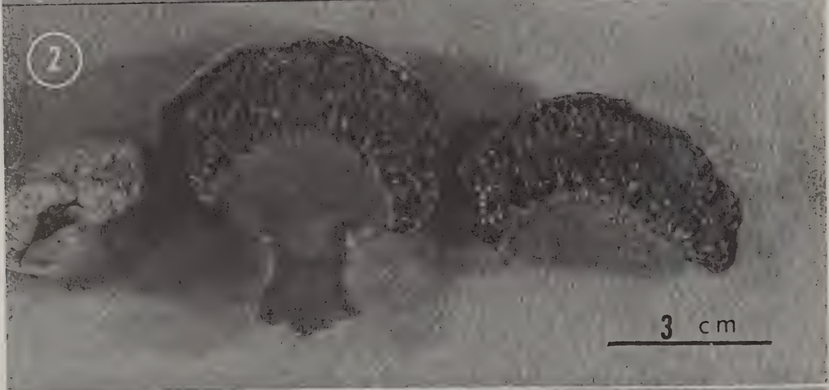
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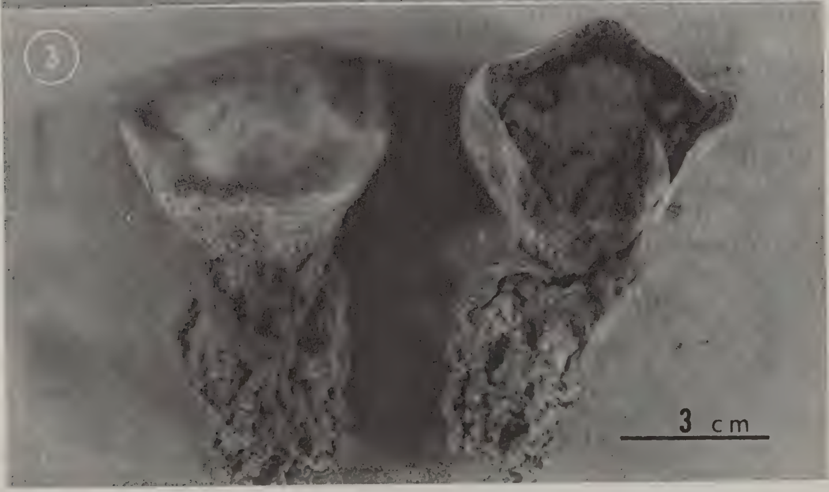
3
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other as *S. bovista sensu* Bresadola. Zeller (1947) based his species *S. arenicola* upon Coker and Couch's *S. bovista sensu* Bresadola, recognizing it as distinct from *S. bovista* Fries *sensu* Hollos.

Among the specimens cited by Coker and Couch (1974) for the *S. bovista sensu* Bresadola group is one collected on Smith's Island, North Carolina, in sandy soil near the sea, a habitat similar to that in which the Rhode Island specimen was found. Zeller (1974) also cites a specimen from the Oregon coast found near the sea. These records suggest that *S. arenicola* may be a characteristic inhabitant of saline sand dunes, and is perhaps mycorrhizal on sand dune vegetation.

Specimen examined: On beach sand, Scarborough Beach State Park, October, 1993. Coll. Amy O'Donnell.

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It is a pleasure to acknowledge several students who have contributed to this work, especially Stephanie Digby, Alex Frost and Amy O'Donnell. I am also grateful to James Ginns, Orson Miller, and Gary Samuels for help with identification and with literature. I am especially grateful to Dr. Jim Ginns for his very helpful pre-submission review.

Figs. 1-4. Rhode Island fungi. Fig. 1. Ascoma of *Camarops petersii*. Fig. 2. Basidioma of *Pisolithus tinctorius*. Figs. 3 & 4. *Scleroderma arenicola*. 3. Basidioma with rhizomorphs. 4. Basidiospores.

References

Bandoni, R.J. and F. Oberwinkler. 1980. *Hyalopycnis blepharistoma*: a pycnidial basidiomycetes. Can. J. Bot. 59: 1613-1620.

Coker, W.C. and J.N. Couch. 1974. (1927). *The Gasteromycetes of the eastern United States and Canada.* Reprinted by Dover Publications, New York. 201 pp.

Fergus, C.L. 1973. *Peridoxylon petersii* on oak in Pennsylvania. Mycologia 65: 1199-1200.

Hawksworth, D.L., P.M. Kirk, B.C. Sutton and D.N. Pegler. 1995. *Dictionary of the fungi.* Eighth Edition. International Mycological Insitute, Egham, Surrey, U.K.

Heagle, R. and D.W. French. 1980. *Peridoxylon petersii* on oak in Minnesota. Mycologia 64: 1349.

Hilber, R. and O. Hilber. 1980. Notizen sur Gattung *Camarops* (Boliniaceae). Ceska Mykol. 34: 123-151.

Horn, B. 1984. Fertile stromata of *Camarops petersii* in culture. Mycologia 76:956-959.

Hutchison, L.J. 1987. Studies of *Phaeocalicium polyporaeum* in North America. Mycologia 79: 786-789.

Johnson, M.M. 1974. The Gasteromycetae of Ohio. Ohio Biol. Survey Bull. 22, Vol. IV. 271-272. Reprinted in: Coker, W.D. and J.N. Couch. *The Gasteromycetes of the United States and Canada.* Dover Publications Inc. New York. 210 pp. plus supplement.

Miller, O.K. and H.H. Miller. 1988. *Gasteromycetes*. Mad River Press, Eureka, CA 157 pp.

Schoknecht, J.D. and J.L. Crane, 1977. Revision of *Torula* and *Hormiscium* species. *Torula occulta, T. diversa, T. elasticae, T. bigemina* and *Hormiscium condensatum* reexamined. Mycologia 69:533-546.

Smith, A.H. 1951. *Puffballs and their allies in Michigan.* The University of Michigan Press. Ann Arbor. 131 pp.

Zeller, S.M. 1947. More notes on Gasteromycetes. Mycologia 39:282-312.

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LEUCOAGARICUS HORTENSIS : SOME SYNONYMS FROM FLORIDA AND TAXONOMIC OBSERVATIONS

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ABSTRACT

Three species of *Lepiota* sensu lato described from Florida are synonymized with *Leucoagaricus hortensis* (Murr.) Pegler. These species are: *L. humei* Murrill, *L. mammillata* Murrill, and *L. subfulvidisca* Murrill. This conclusion was based upon type studies, which indicated agreement between details of the basidiospores, basidia, cheilocystidia, and pileipellis. Problems in classification of this species according to current taxonomic concepts are discussed.

INTRODUCTION

Species of *Lepiota* sensu lato from Florida have been a subject of systematic research in our laboratory for several years. During the course of this work, we have concluded that three species described as new from north central Florida (Murrill 1943) are synonymous. These species are: *Lepiota humei* Murr., *Lepiota mammillata* Murr., and *Lepiota subfulvidisca* Murr. The types of *L. mammillata* and *L. subfulvidisca* have not, to our knowledge, been previously treated to intensive microscopic investigation. This article therefore not only proposes synonymy for these species, but also provides the first detailed report on their micromorphological characters. All three of these species have, in turn, been determined as synonyms of *Leucoagaricus hortensis* (Murr.) Pegler. By virtue of an earlier date of publication (Murrill 1914: 59), this should be regarded as the correct name for this fungus.

MATERIALS AND METHODS

Specimens were borrowed for study from the following herbaria: NY (*L. hortensis*), and FLAS (*L. humei*, *L. mammillata*, and *L. subfulvidisca*). Small tissue samples were excised, wetted in 95% ethanol, then revived in water. Hand sections were cut and mounted in 3% KOH, Melzer's reagent, and cresyl blue in aqueous solution, following standard mycological methods (Smith 1949; Largent et al. 1977; Singer 1986). Some slide-mounts were gently squashed to separate elements for optimum visualization. Light microscopy studies were carried out at 400 and 1000 X, and line drawings were made using a Leitz drawing tube. Size ranges of basidiospores, basidia, cheilocystidia and pileipellis were based on ocular micrometer measurements of at least 12-15 elements of each type from each collection studied.

Descriptions were prepared based exclusively on the type collections, except in the case of *L. humei*. Due to poor preservation, and considering the availability of paratypes, data presented on the pileipellis of *L. humei* were gathered from FLAS F 18044. Because herbarium collections are potentially subject to predation by museum pests and deterioration over time, brief descriptions of macromorphological features visible in dried specimens are provided. Colors noted in descriptions are personal interpretations, followed by references in parentheses to centroid colors of the ISCC-NBS illustrated color name charts (Kelly and Judd 1965), in which the number cited is that of the color chip in the chart, and the letter sequence denotes the name of the color in abbreviated form. Data on additional collections were gathered and, where different, are presented under the heading "Additional data".

RESULTS

Leucoagaricus hortensis (Murr.) Pegler, *Kew Bull. add. ser.* 9: 414-415 (1983) Figs. 1, 2

= *Lepiota hortensis* Murr.
= *Lepiota humei* Murr.
= *Lepiota mammillata* Murr.
= *Lepiota subfulvidisca* Murr.

Holotype: NY, s. n. Sandy soil in garden. Auburn, Lee Co., Alabama, USA. Sept. 2, 1899, Mrs. F. S. Earle, coll.

Macroscopic features of the dried collection: 3 basidiomata present, fairly intact; overall condition good. Pileus 2-5.9 cm broad, plano-convex, umbonate. Margins decurved to incurved, short-sulcinate. Cuticle dull yellow ochraceous (71. m. OY; 76. l. y Br), smooth, intact at the disc, elsewhere disrupted into flat, appressed, irregularly shaped scales up to 3 mm broad, excoriating toward the margin and leaving an irregularly concentric distribution pattern. Trama paler dull yellow ochraceous, texture fine, smooth to silky, radially arranged. Lamellae pale, concolorous (70. l. OY; 71. m. OY). Stipe 2 to 5 cm long, diameter 3-5 mm, with bulbous base, diameter up to 8 mm, concolorous; annulus persistent, membranous, double-edged, fixed, concolorous, median to inferior.

Micromorphological features: Basidiospores (Fig. 2F) 7.3-11.2 x 5.9-7.8 µm (Q = 1.37); ellipsoidal to ovoid, smooth, hilar appendix prominent; wall thick (circa 0.5 µm), germ pore apparently lacking; hyaline in KOH, dextrinoid (orange brown to reddish brown in Melzer's reagent), metachromatic in cresyl blue but often difficult to distinguish as such. Basidia (Fig. 2D) 16.2-25 x 6.6-9.2 µm; clavate, bisterigmate, smooth, thin-walled, inflated, sterigmata conspicuous with basal portion somewhat swollen, hyaline in KOH. Cheilocystidia (Fig. 2E) 25-64 x 6.3-10.8 µm, long and thin, subcylindric to subcapitate to narrowly clavate, some slightly flexuous; apices mostly broadly rounded, occasionally bearing a papillate or rostrate appendage up to 43 µm long with wall thinner, faint; walls smooth, thin; hyaline in KOH, inamyloid and not dextrinoid in Melzer's reagent. Pleurocystidia lacking. Lamellar trama roughly parallel to irregularly interwoven, hyaline to pale yellow in KOH, yellow in Melzer's reagent, including occasional oleiferous hyphae with refringent, homogeneous content, amber-yellow in KOH, deeper amber in Melzer's reagent. Pileus trama hyaline to light yellow in KOH, yellow in Melzer's reagent, with conspicuous, oleiferous hyphae, tortuous, with homogeneous, refringent content, amber-yellow in KOH, deeper amber in Melzer's reagent, walls contrasting sharply with focus. Pileipellis (Figs. 2A and 2B) a subhymeniform layer of upright elements, long-clavate to subclavate, some septate, terminal cells 49-125 x 11-15 µm, apices rounded, rising to various levels, rarely with a papillate to rostrate appendage; oleiferous hyphae originating from trama and proliferating through subhymeniform layer, emerging to form an epicuticular mat, thickest at the disc; contents homogeneous to granular-amorphous, yellow in KOH, deeper yellow in Melzer's reagent. Clamp connections present in cuticle of stipe, elsewhere not noted.

Additional data: Annulus fixed, or detached from the stipe while yet remaining intact (NY 2761). Basidiospores from 7.3 x 5 µm (NY s. n., "Bres. 13") up to 13 x 7.9 µm (NY 2842). Cheilocystidia as short as 21.5 µm (NY 2761). Upright elements of the pileipellis showed the greatest variation in form, and the greatest degree of septation, in NY 2761. Terminal elements occasionally tapered or rarely bifurcated.

Other collections studied:

NY 2761. Pasture. Auburn, Lee Co., Alabama, USA. Aug. 8, 1898, F. S. Earle, coll.
NY 2842. Garden. Auburn, Lee Co., Alabama, USA. July, 1900, F. S. Earle, coll.
NY s. n. ("31. Lepiota"). Pasture. Alabama, USA. Oct. 10, 1900, F. S. Earle, coll.
NY s. n. ("32. Lepiota"). Pine woods. Alabama, USA. Oct. 10, 1900, F. S. Earle, coll.
NY s. n. ("Bres. 13"). Pine woods. Alabama, USA. Oct. 10, 1900, G. Bresadola, coll.

Comments. *Leucoagaricus hortensis* is a fairly well-known species. The type collection has been previously studied and reported on by other workers, including R. W. G. Dennis (1952), H. V. Smith (1966), and D. N. Pegler (1983) who transferred it to *Leucoagaricus*. The type has also been studied by A. Franco (1994). This is a widespread neotropical species, reported from Venezuela, Colombia, the Caribbean, Mexico, and the Gulf Coastal USA. It occurs commonly in cattle and horse pastures, often directly on their manure, and has also been reported from sandy soils, meadows and gardens (Murrill 1914; Dennis 1952; Pegler 1983; Rodriguez G. 1990; Franco 1994).

Based on study of the type and other Murrill-determined collections (Fig. 1), *L. hortensis* is a unique species. Its overall aspect recalls a small species of *Macrolepiota* or *Chlorophyllum molybdites* (Meyer: Fr.) Massee but with a pale cream spore deposit. Among its *Macrolepiota*-like features are an excoriating pileus cuticle with a roughly concentric pattern of squamulation, and a double-edged, membranous annulus that can sometimes become detached, especially in robust specimens. The pileipellis (Fig. 2A) is intermediate in type between a trichodermial palisade and hymenoderm. Previous workers have described this as a trichodermium (Franco 1994) or trichodermial palisade (Pegler 1983). Based on Largent et al. (1977) this feature is reinterpreted here, because the elements are roughly parallel, nonfiliform, typically do not branch, and scarcely intertwine. A system of oleiferous hyphae (Fig. 2C), originating in the trama, proliferates through the pileipellis and emerges to form a tangled, interwoven, epicuticular mat, thickest at the disc, giving it a distinct, cadmium yellow tint there early in fruit-body development (see Pegler 1983, color plate 12). With maturation, this yellow changes to a dull, light brown, due to some apparent breakdown of the epicuticular

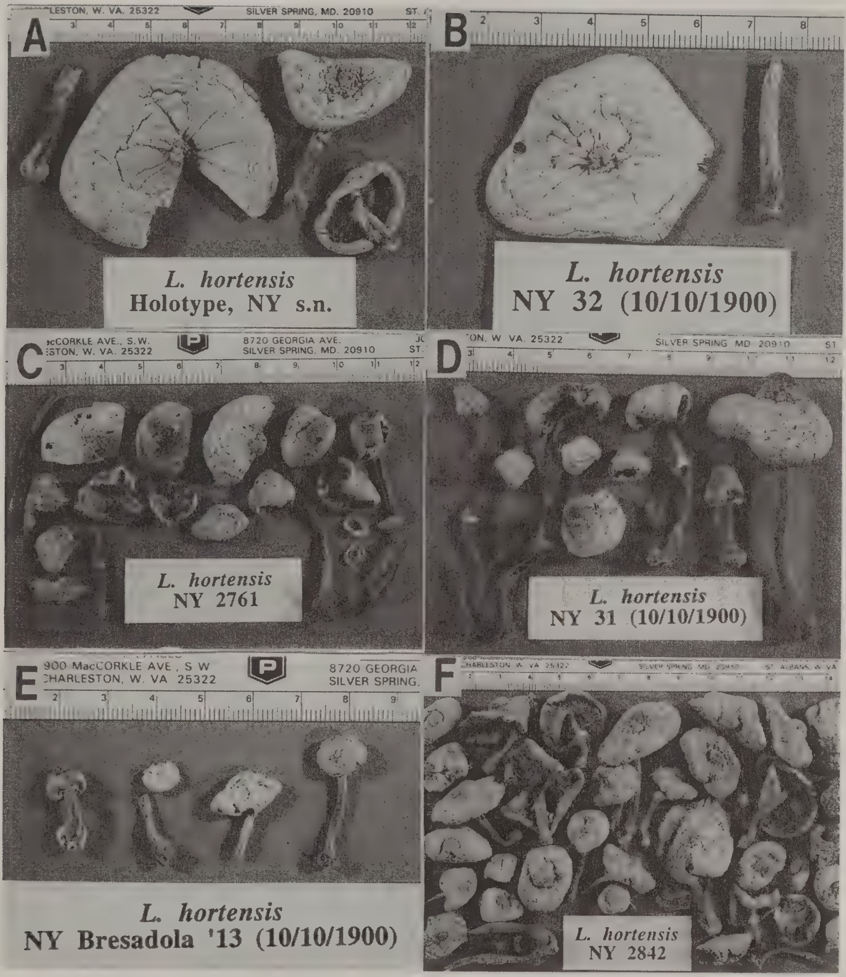


Fig. 1. Collections of *L. hortensis*. A. Holotype. B-F. Other collections determined by Murrill.

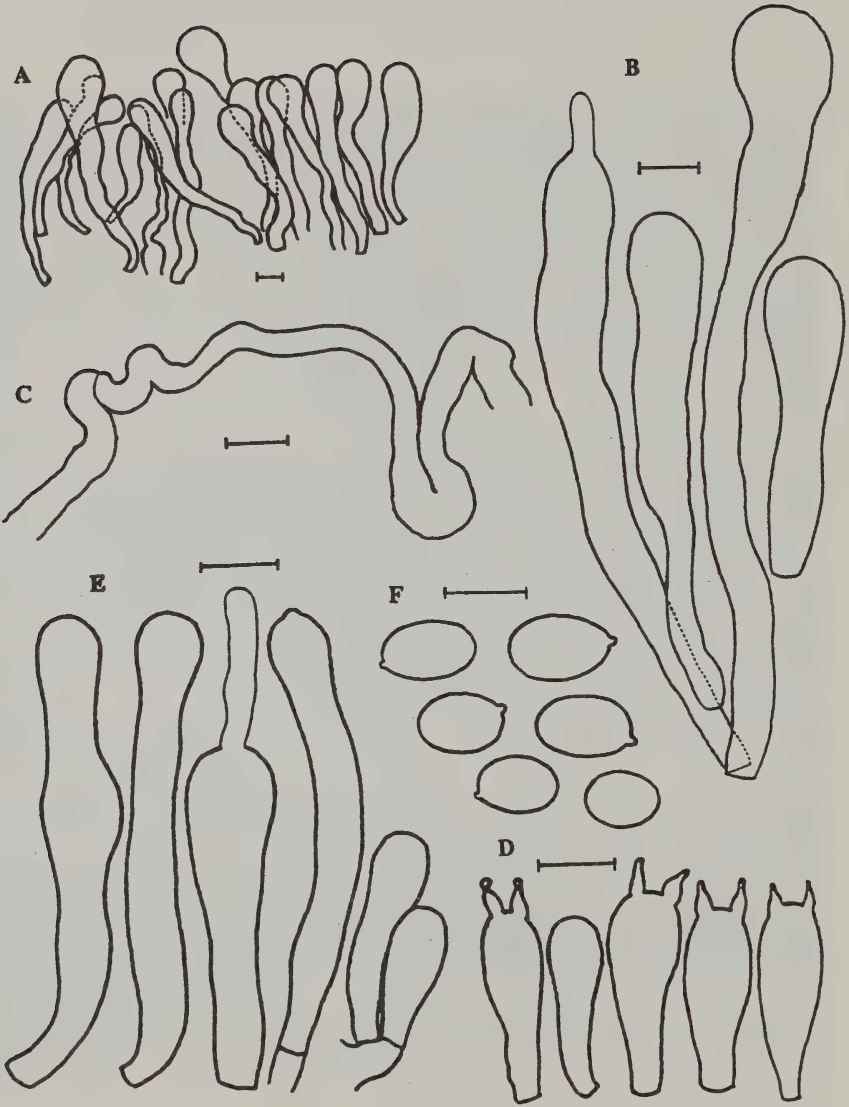


Fig. 2. Micromorphology of *L. hortensis*. A. Pileipellis, showing orientation of terminal elements. B. Terminal elements of pileipellis. C. Oleiferous hypha of trama. D. Hymenial elements including basidia. E. Cheilocystidia. F. Basidiospores. Scale lines = 10 µm.

hyphae or their contents. This combination of a subhymeniform pileipellis with epicuticular, oleiferous hyphae is an unusual and distinctive feature of this species.

The hymenium of this species is also unusual, with typically bisporic basidia (Fig. 2D), as noted previously by Smith (1966), Pegler (1983), and Franco (1994). Rare tetrasporic basidia in the type collection, reported by the latter author, were not observed. Sterigmata in this species are large and conspicuous, with the basal portion often swollen, and the thinner apical portion erect or deflated. The edges of the lamellae are crowded with long, thin, irregularly cylindric to slightly clavate cheilocystidia (Fig. 2E).

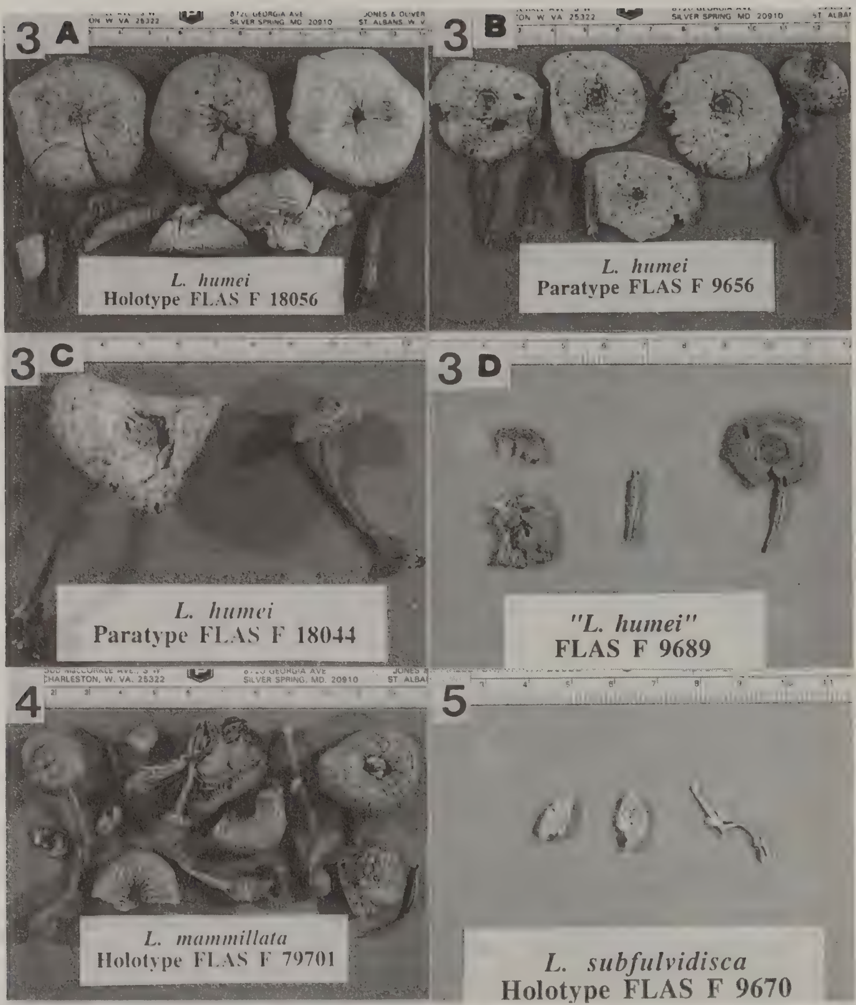
The basidiospores (Fig. 2F) are ellipsoidal and thick-walled, similar to those of *Macrolepiota* but lacking a conspicuous apical germ pore as seen under light microscopy. In Melzer's reagent, the spores are dextrinoid. In cresyl blue, metachromatic response is slight in the majority of spores, but easily observed in others, especially crushed or immature examples. In the former, the endosporium is conspicuously red, while the latter tend to appear purple, a chromatic effect resulting from the filtering of light through the reddened endosporium against the blue-dyed protoplast. The weakness of the metachromatic response in the majority of spores is consistent and typically pronounced, and can lead to a mistaken judgement that the spores are not metachromatic if one is not careful.

Following are descriptive notes, based on studies of the types, of the three *Lepiota* species for which we are proposing synonymy with *L. hortensis*.

Lepiota humei Murrill, *Lloydia* 6: 220 (1943) Figs. 3, 6

Holotype: FLAS F 18056. Dry soil. North side of Payne's Prairie near Gainesville, Alachua Co., Florida, USA. July 29, 1938, H. and H. N. Hume, colls.

Macroscopic features of the dried collection: 4 basidiomata present, partially disintegrated due to predation by herbarium pest; overall condition poor. Pileus 2-5 cm broad, plano-convex, umbonate. Margins decurved to incurved, with short sulci up to 1 cm long. Cuticle pale ochraceous brown (76. l. yBr; 71. m. OY), smooth, intact only at the disc, disrupted elsewhere into irregularly shaped scales up to 3 mm broad, peeling away from the trama at their edges, excoriating toward the margin and leaving an irregularly scattered, subconcentric distribution pattern. Trama lighter ochraceous brown, texture fine, smooth to silky, radially arranged. Lamellae deep cream, tinged ochraceous (70. l. OY). Stipe up to 6 cm long, diameter 2.5-4 mm, with bulbous base up to 8 mm in diameter; dingy pale ochraceous



Figs. 3-5. Collections of taxa from Florida synonymous with *L. hortensis*. **3.** *L. humei*. A. Holotype. B-C. Confirmed paratypes. D. Excluded paratype, identified as *Leucocoprinus longistriatus*. **4.** Holotype of *L. mammillata*. **5.** Holotype of *L. subfulvidisca*.

brown (80. gy. yBr; 77. m. yBr); annulus persistent, membranous, double-edged, detached, concolorous.

Micromorphological features: Basidiospores (Fig. 6A) 8-13.5 x 6-8.5 µm (Q = 1.58); ellipsoidal to ovoid, smooth, hilar appendix prominent; wall thick (0.5-0.8 µm), germ pore apparently absent but a few with wall thinning slightly at the apex; hyaline in KOH, moderately dextrinoid (pale rusty orange to deeper orange brown in Melzer's reagent), metachromatic but metachromasy difficult to observe in most, clearly observed mainly in crushed, immature, or exceptional examples. Basidia (Fig. 6D) 17.5-30 x 7-9.5 µm; clavate, bisterigmate, smooth, thin-walled, inflated or collapsing, sterigmata large and conspicuous, up to 4.5 x 2 µm, sometimes with basal portion distinctly swollen, hyaline in KOH. Cheilocystidia (Fig. 6B) 32.5-55 x 5.5-9 µm, long and thin, subcylindric to subcapitate to narrowly clavate, often slightly flexuous; apices mostly broadly rounded, a few tapering slightly or rarely papillate; walls smooth, thin; hyaline in KOH, inamyloid and not dextrinoid in Melzer's reagent. Pleurocystidia lacking. Lamellar trama roughly parallel to irregularly interwoven, hyaline to light yellow in KOH, yellow in Melzer's reagent, including occasional oleiferous hyphae with refractive content, amber-yellow in KOH, deeper amber in Melzer's reagent. Pileus trama hyaline to light yellow in KOH, yellow in Melzer's reagent, with conspicuous, oleiferous hyphae, tortuous, with homogeneous, refringent content, amber-yellow in KOH, deeper amber in Melzer's reagent, walls contrasting sharply with focus. Pileipellis (Figs. 6C and 6E) a subhymeniform layer of upright elements, long-clavate to subclavate, a few septate, terminal cells 36.5-68 x 10-14.5 µm, apices rounded, rising to various levels; oleiferous hyphae originating from trama and proliferating through subhymeniform layer, emerging to form a tangled, oleiferous, epicuticular mat, thickest at the disc; contents yellow in KOH, slightly refractive, homogeneous to granular-amorphous, often partially degraded or collapsed, slightly deeper yellow in Melzer's reagent. Clamp connections present in cuticle of stipe, not observed elsewhere.

Additional data: Annulus completely to partially fixed or becoming detached from stipe but remaining intact (FLAS F 9656). Basidiospore length as little as 7.5 µm (FLAS F 18044 and 9656), minimum width 5.3 µm (FLAS F 18126). Cheilocystidia as small as 4 µm in diameter and 25 µm in length (FLAS F 55643). Cheilocystidia more variable in FLAS F 18044, occasionally with tapering apices or rostrate extensions, and rarely bifurcate.

Other collections studied:

FLAS F 9656 (Paratype). Soil in a vegetable garden. Gainesville, Alachua Co., Florida, USA. Nov. 11, 1931, W. A. Murrill, coll.

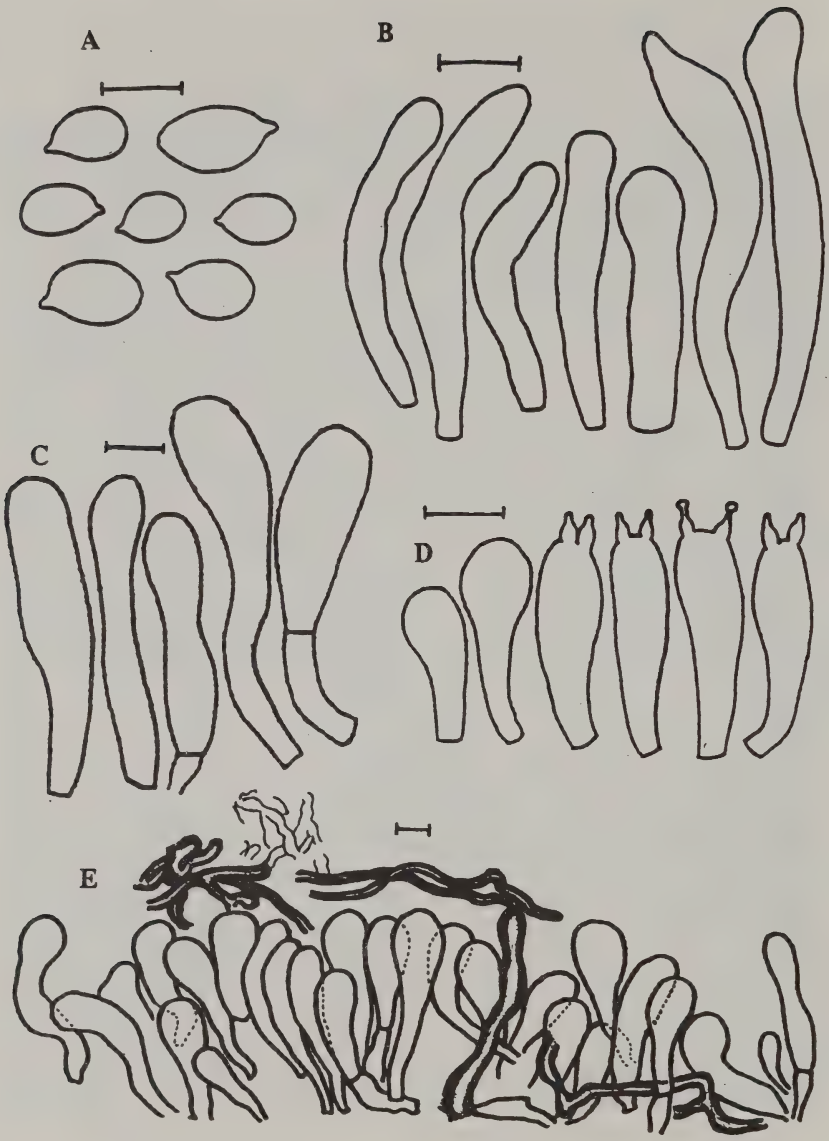


Fig. 6. Micromorphology of *L. humei*. A. Basidiospores. B. Cheilocystidia. C. Terminal elements of pileipellis. D. Hymenial elements including basidia. E. Pileipellis, showing oleiferous hyphae among upright elements (lower right) and forming epicuticular mat (upper left). Scale lines = 10 µm.

FLAS F 9697. Compost. Gainesville, Alachua Co., Florida, USA. July 26, 1927, A. F. Camp, coll. E. West, detm.
FLAS F 18044 (Paratype). Old cow dung. Grove Park, Alachua Co., Florida, USA. July 10, 1938, E. West, coll.
FLAS F 18126. Sandy soil in flower bed with cow manure. Cocoa, Brevard Co., Florida, USA. Sept. 11, 1938, A. S. Rhoads, coll.
FLAS F 19496. Open field. Gainesville, Alachua Co., Florida, USA. Nov. 6, 1938, W. B. Tisdale, coll.
FLAS F 55643. Pasture. Hague, Alachua Co., Florida, USA. June 16, 1990, B. Akers, coll. and detm.

Comments. Unlike *L. mammillata* and *L. subfulvidisca*, the micromorphology of the type of this species has been previously reported on (Smith 1966). Since then, this species has become better known via coverage in some popular field guides (Smith and Smith 1985; Arora 1986; Metzler and Metzler 1992). It has also been implicated in unsubstantiated reports of neuropharmacological activity in *Lepiota* species (Akers 1992). Murrill's (1943) description was based upon the holotype and three other cited collections. Two of these (FLAS F 9656, Fig. 3B; and FLAS F 18044, Fig. 3C) are typical *L. humei* and thus good paratypes. But the other collection, FLAS F 9689 (Fig. 3D), is *Leucocoprinus longistriatus* (Pk.) H. V. Smith and Weber.

Four other vintage collections determined as *L. humei* were noted in the FLAS herbarium, three determined by Murrill and one by E. West. Of these, we have determined three (FLAS F 18126, F 9697, and F 19496) as *L. hortensis*, while the fourth (FLAS F 17902) appears to be a collection of, again, *L. longistriatus*.

Murrill (1914) had already described *L. hortensis*, but provided no information as to why he considered *L. humei* distinct from it. H. V. Smith (1966) reported on the micromorphology of the types of *L. humei* and *L. hortensis* in the same article, but did not note their conspecificity. Her description of the pileipellis of *L. humei*, however, represents an excellent account of this feature for *L. hortensis*. Good color photographs of *L. humei* have been published in Smith and Smith (1985) and Metzler and Metzler (1992). The mushroom shown in these photographs appears identical to that depicted in Pegler's color plate of *L. hortensis* (1983). The field characters of both also match, including the fact that the flesh of both exhibits a characteristic reddish bruising reaction (Dennis 1952; Pegler 1983; Smith and Smith 1985; Rodriguez G. 1990; Metzler and Metzler 1992; Franco 1994).

Lepiota mammillata Murrill, *Lloydia* 6: 220 (1943) Figs. 4, 7

Holotype: FLAS F 9701. In rich, open soil. Gainesville, Alachua Co., Florida, USA.

Macroscopic features of the dried collection: 4 basidiomata present; condition fair. Pileus 2.3-4.1 cm broad, plano-convex, umbonate. Margins incurved, short-sulcinate. Most of cuticle pale, dull ochraceous brown, scarcely vinaceous (33. br Pink), the umbo yellow brown (71. m. OY), smooth, intact only at the disc, disrupted elsewhere into irregularly shaped scales up to 3 mm broad, peeling away from the trama at their edges, excoriating toward the margin and leaving an irregularly scattered, subconcentric distribution pattern. Trama lighter dull ochraceous brown, texture fine, smooth to silky, radially arranged. Lamellae dirty cream (89. p. Y; 90. gy. Y). Stipe up to 5.2 cm long, diameter 1.5-3.5 mm, with bulbous base up to 6 mm in diameter; pale ochraceous brown (77. m. yBr); annulus persistent, membranous, double-edged, fixed, concolorous.

Micromorphological features: Basidiospores (Fig. 7A) 8.5-13.5 x 5.9-8.3 µm (Q = 1.55); ellipsoidal to ovoid, smooth, hilar appendix prominent; wall thick (ca. 0.5 µm), germ pore appearing as if absent but a few with slightly thinning wall at the apex; hyaline in KOH, moderately dextrinoid (pale rusty orange to deeper orange brown in Melzer's reagent), metachromatic but metachromasy difficult to observe in most, clearly observed mainly in crushed, immature, or exceptional examples. Basidia (Fig. 7D) 14.5-19 x 6-7.2 µm; clavate, bisterigmate, smooth, thin-walled, often deformed or collapsing, sterigmata large and conspicuous, sometimes with basal portion distinctly swollen, hyaline in KOH. Cheilocystidia (Fig. 7B) 30-48.5 x 4.8-8.5 µm, long and thin, subcylindric to subcapitate to narrowly clavate, some slightly flexuous; apices broadly rounded; walls smooth, thin; hyaline in KOH, inamyloid and not dextrinoid Melzer's reagent. Pleurocystidia lacking. Lamellar trama roughly parallel to irregularly interwoven, hyaline to light yellow in KOH, deeper yellow in Melzer's reagent, including occasional oleiferous hyphae with refractive content, amber-yellow in KOH, deeper amber in Melzer's reagent. Pileus trama hyaline to light yellow in KOH, yellow in Melzer's reagent, including oleiferous hyphae, conspicuous, tortuous, with homogeneous, refringent content, amber-yellow in KOH, deeper amber in Melzer's reagent, walls contrasting sharply with focus. Pileipellis (Fig. 7C) a subhymeniform layer of upright elements, some septate, diameter 9.5-12.5 µm (length not measurable due to poor revival), apices rounded; oleiferous hyphae originating from trama and proliferating through subhymeniform layer, emerging to form a tangled, oleiferous, epicuticular mat, thickest at the disc; contents yellow in KOH, slightly refractive, homogeneous to granular-amorphous, often partially degraded or collapsed, slightly deeper yellow in Melzer's reagent. Clamp connections (Fig. 7E) present in cuticle of stipe, not noted elsewhere.

Comments. Murrill's concept and description of this species was based entirely on the type collection, and no other specimens of it determined by Murrill are known to us. He described the pileus of this species as white with isabelline umbo, which contrasts little with his description of *L. humei*, white with pale ochraceous-isabelline umbo. However, his spore measurements for the two species differ considerably: 9 x 6 µm for *L. humei*, and 11-12 x 6 µm for *L. mammillata*. This may be one reason he described them as different species. Our observations have not substantiated this difference, however, and there seems to be no basis for maintaining them as separate from each other, nor from *L. hortensis*. This is a fairly typical *L. hortensis* collection, although its pale brown color has a faintly rosy cast compared to others.

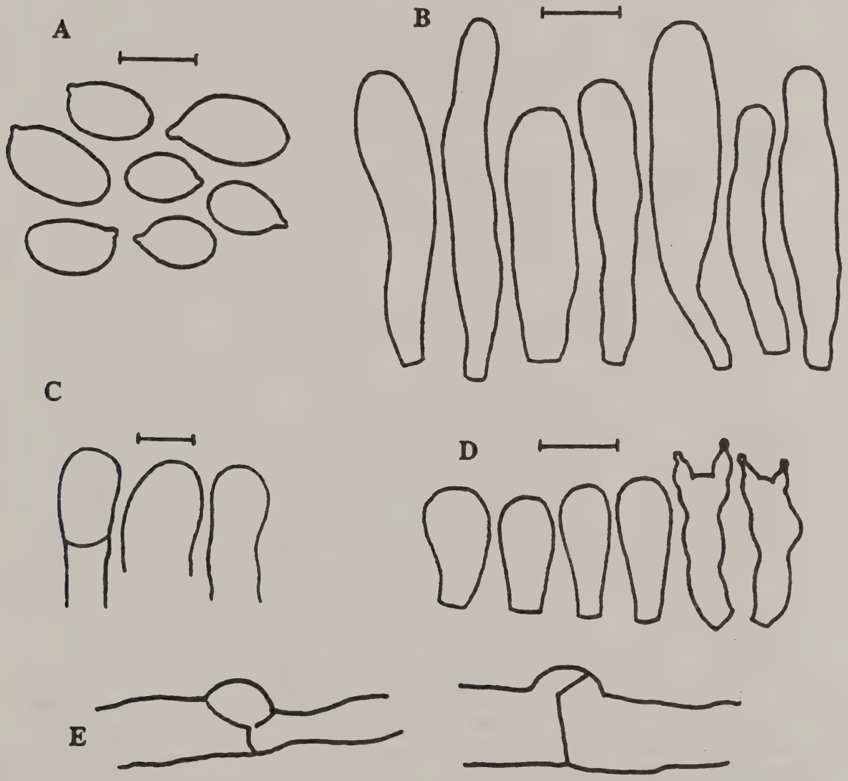


Fig. 7. Micromorphology of *L. mammillata*. A. Basidiospores. B. Cheilocystidia. C. Terminal elements of pileipellis. D. Hymenial elements including basidia. E. Clamp connections of stipitipellis. Scale lines = 10 µm.

One other collection identified as this species (FLAS F 52863) was found in the FLAS herbarium. Collected from Gainesville and determined by J. Gibson in 1981, little remains of it but a few fragments. From these, it appears to be *L. longistriatus*.

Lepiota subfulvidisca Murrill, *Lloydia* 6: 221 (1943) Figs. 5, 8

Holotype: FLAS F 9670. Lawn. Gainesville, Alachua Co., Florida, USA. Nov. 8, 1932, W. A. Murrill, coll.

Macroscopic features of the dried collection: 1 basidioma present; condition fair. Pileus 1.2 cm broad, plano-convex, umbonate. Margins incurved, short-sulcinate. Most of cuticle pale ochraceous brown (76. l. yBr; 71. m. OY), the umbo yellow brown (71. m. OY), smooth, intact only at the disc, disrupted elsewhere into irregularly shaped scales, peeling away from the trama at their edges, excoriating toward the margin and leaving an irregularly scattered, subconcentric distribution pattern. Trama lighter ochraceous brown, texture fine. Lamellae deep cream, tinged ochraceous (70. l. OY). Stipe circa 2 cm long, diameter 1-1.5 mm; pale ochraceous brown (80. gy. yBr; 77. m. yBr); annulus persistent, membranous, fixed, concolorous to whitish.

Micromorphological features: Basidiospores (Fig. 8A) 8-13 x 5.8-8.5 µm (Q = 1.49); ellipsoidal to ovoid, smooth, hilar appendix prominent; wall thick (0.5-0.8 µm), germ pore apparently absent but a few with slightly thinning wall at the apex; hyaline in KOH, moderately dextrinoid (pale rusty orange to deeper orange brown in Melzer's reagent), metachromatic but metachromasy difficult to observe in most, clearly observed mainly in crushed, immature, or exceptional examples. Basidia (Fig. 8D) 16.5-21.5 x 5.5-7 µm; clavate, bisterigmate, smooth, thin-walled, inflated or collapsing, sterigmata large and conspicuous, sometimes with basal portion distinctly swollen, hyaline in KOH. Cheilocystidia (Fig. 8B) 28-46 x 5.8-8.5 µm, long and thin, subcylindric to subcapitate to narrowly clavate, often slightly flexuous; apices broadly rounded, a few tapering slightly or rarely rostrate; walls smooth, thin; hyaline in KOH, inamyloid and not dextrinoid in Melzer's reagent. Pleurocystidia lacking. Lamellar trama roughly parallel to irregularly interwoven, hyaline to pale yellow in KOH, yellow in Melzer's reagent, including occasional oleiferous hyphae with refringent, homogeneous content, amber-yellow in KOH, deeper amber in Melzer's reagent. Pileus trama hyaline in KOH, slightly yellow in Melzer's reagent, including oleiferous hyphae, conspicuous, tortuous, with amber-yellow content in KOH, deeper amber in Melzer's reagent, walls contrasting sharply with focus. Pileipellis (Fig. 8C) a subhymeniform layer of upright elements, long-clavate to subclavate, some septate, the terminal cells 27-32 x 6-14 µm, apices rounded, rising to various levels; oleiferous

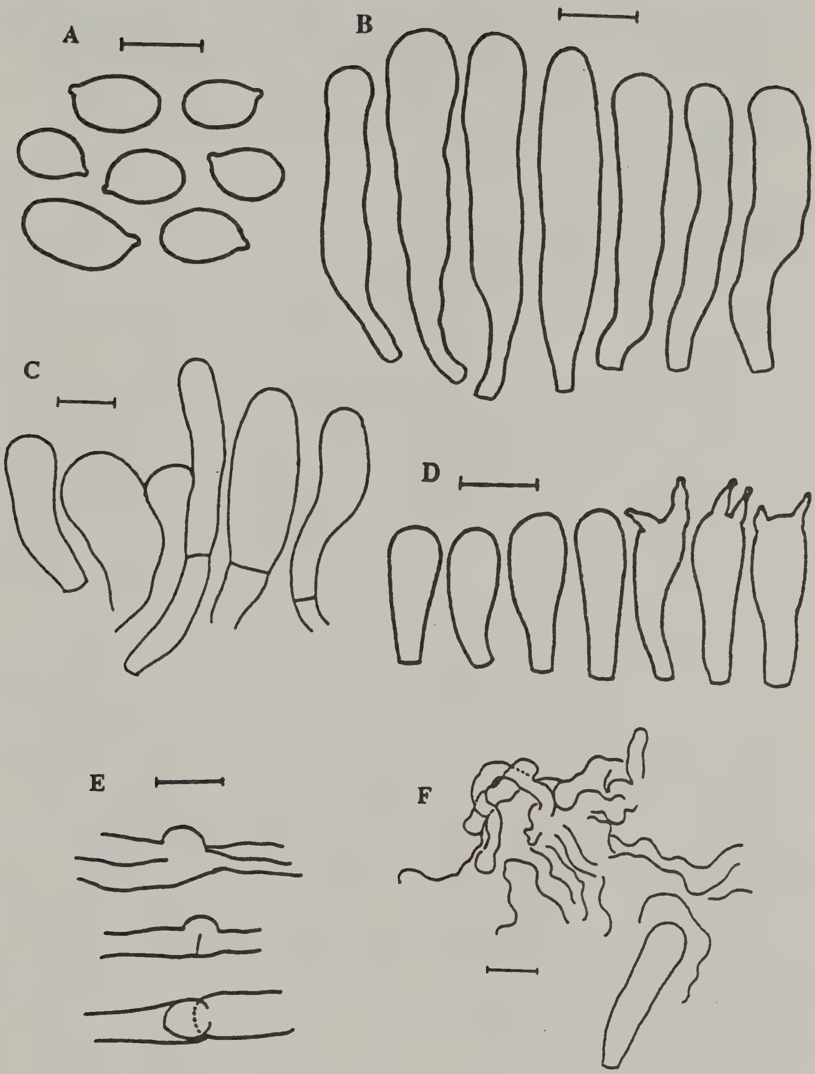


Fig. 8. Micromorphology of *L. subfulvidisca*. A. Basidiospores. B. Cheilocystidia. C. Terminal elements of pileipellis. D. Hymenial elements including basidia. E. Clamp connections of stipitipellis. F. Epicuticular mat of oleiferous hyphae. Scale lines = 10 µm.

hyphae originating from trama proliferating through subhymeniform layer and emerging to form a tangled, oleiferous, epicuticular mat (Fig. 8F), thickest at the disc (circa 30 µm); contents yellow in KOH, refractive, homogeneous to granular-amorphous, often partially degraded or collapsed, slightly deeper yellow in Melzer's reagent. Clamp connections (Fig. 8E) present in cuticle of stipe, not noted elsewhere.

Other collections studied:

FLAS F 18758. Cultivated soil. Gainesville, Alachua Co., Florida, USA. Oct. 2, 1938, W. A. Murrill, coll.

FLAS F 52355. Sandy soil, grass. Gainesville, Alachua Co., Florida, USA. July 20, 1980. M. Edmonton, coll. and detm.

Comments. Although smaller in size than most, this collection's bisporic basidia, characteristic spores, cheilocystidia, and pileipellis clearly distinguish it as *L. hortensis*. Murrill himself compared it to "a small *L. mammillata*" (1949: 60). In his brief protolog discussion (1943) he also mentions, without reference data, several other collections that had been made of this taxon. It is unclear just how exclusively based on the type Murrill's description of this species is. He describes the pileus as 2.5-4 cm in diameter; yet the type consists of a single small specimen, with a probable pileus diameter of no more than 2.5 cm fresh, insufficient to establish the upper measured limit.

In 1949 Murrill noted, again without citations, that nine collections from lawns, three from under oaks, and one from under pines had been made. But only two other Murrill-determined collections have been located, both from Gainesville in 1938, and the status of the other eleven is unknown. Both of the collections found pose problems. Of one (FLAS F 18758), nothing remains but a scant, dusty debris. The other (FLAS F 9268), labelled "rimose form", turns out to be an altogether different *Leucoagaricus* species with smaller spores, a thinner membranous annulus, and a deeper brown, radially fibrillose-appressed cuticle, disrupting primarily in a radial pattern. If the species concept is based in any part upon this collection, it must reflect this apparent inconsistency. Another collection labelled *L. subfulvidisca* (FLAS F 52355) has proven to be a typical *L. hortensis*.

DISCUSSION

Modern authors recognize two tribi within *Lepiota* sensu lato: Lepioteae Fayod, species of which have nonmetachromatic spores and various partial veil morphologies; and Leucocoprineae Singer, with metachromatic spores and a characteristically membranous partial veil. In addition, segregate genera have been proposed, such as *Leucocoprinus* Pat., *Leucoagaricus* (Locquin) Sing., and *Macrolepiota* Sing. among the Leucocoprineae (Bon 1981; Singer 1986; Candusso and Lanzoni 1990).

Application of these newer generic concepts can be problematic due to different usages by different authors. In particular, *L. hortensis* appears to pose an interesting challenge for the distinction between *Leucoagaricus* and *Macrolepiota.*

In his definition of *Macrolepiota*, Singer (1986: 472) cites "broad germ pore" as a generic character. Of *Leucoagaricus*, he states "often with a germ pore but...pore in some species entirely wanting" (474). This would seem to indicate *L. hortensis*, because its spore lacks a prominent apical pore, belongs in *Leucoagaricus* as Pegler (1983) has proposed, and this may have been the basis for his proposal. Singer (1986) also notes, however, in his definition of *Leucoagaricus* "hyphae without clamp connections" (474), and "differs from *Macrolepiota* in the absence of clamps" (472). Singer recognizes one species of *Macrolepiota* without clamps, but makes no mention of any species with spores lacking a germ pore. However, he also refers to clamp connections in *Macrolepiota* as "the most decisive character" for distinguishing it from *Leucoagaricus*, i.e., that no *Leucoagaricus* species have clamp connections: "...the character as such is dependable and sharp--either positive or negative" (475). No exceptions are cited. In this regard, it seems that Singer's concept would place *L. hortensis*, because of its distinct clamp connections, in *Macrolepiota*, in effect requiring recognition of a *Macrolepiota* species with spores lacking a prominent apical pore.

Bon (1981) places less emphasis on clamp connections, noting for *Macrolepiota* that clamps are *often* present . Of *Leucoagaricus* and *Leucocoprinus*, he indicates that clamps are *generally* absent (emphases added), always so in the small to average size species. This indicates some possible allowance for the concept of a relatively large *Leucoagaricus* species with clamp connections, although none is cited. The presence of a distinct germ pore is the more decisive character for defining *Macrolepiota* according to Bon. Considering Bon's concept of the distinction between *Macrolepiota* and *Leucoagaricus*, *L. hortensis* may fit more readily into *Leucoagaricus*, whereas it does not fit well into either following Singer's approach.

This taxonomic problem is also evident in a treatment of these genera offered by Candusso and Lanzoni (1990: 42) who note "germ pore and clamp connections almost always present" in *Macrolepiota.* No mention is made in their key of clamp connections being present or absent in *Leucoagaricus.* Thus, *L. hortensis* could fit into either genus under this treatment. In any case, this species poses a dilemma which is not clearly solved by any of these approaches, because it has a nonporate spore indicative of *Leucoagaricus*, but clamp connections suggesting *Macrolepiota.*

Leucoagaricus hortensis is also intermediate between *Macrolepiota* and *Leucoagaricus* in regard to some other features which these authors have attempted to utilize as a basis for separation of these genera. For instance, Bon (1981: 22) states that *Leucoagaricus* species are average to small in size, with the spores generally smaller than 10 (12) µm, whereas *Macrolepiota* species are relatively robust, with spores larger than 10 µm. Candusso and Lanzoni agree, specifying a minimum size for *Macrolepiota* species, "over 10 cm" (1990: 42), but no maximum size for *Leucoagaricus*. In Singer's key, conversely, the couplet leading to *Leucoagaricus*, *Leucocoprinus* and *Sericeomyces* indicates "carpophore rarely larger than 12.5 cm" (1986: 468), but a minimum size for *Macrolepiota* is not given. This matter is further confused by the recognition of many *Macrolepiota* species which seem to contradict some of these criteria for size of fruit body, such as: *M. excoriata* (Sch. :Fr.) Wass., with pileus 5-9 (-11) cm; *M. fuligineosquarrosa* Mal., 6-8 (-10) cm; *M. gracilenta* (Fr.) Wass. 5-8 (-10) cm; and *M. puellaris* (Fr.) Mos., with pileus dimensions given as 5-7 cm (Bon 1981: 69-73). Each of these species is roughly the same size as *L. hortensis*. The character of spore size likewise fails to clarify this issue because *L. hortensis* has spores whose size straddles the supposed boundary between *Macrolepiota* and *Leucoagaricus*. These proposed distinctions, then, do not seem to offer a clear basis for the generic classification of *L. hortensis*, considering its basidiome and spore dimensions.

We consider three possibilities. If, as Singer suggests, clamps are the more important feature, *L. hortensis* clearly belongs in *Macrolepiota*, despite the lack of a germ pore in its basidiospores. Alternately, *L. hortensis* may in fact be correctly placed in *Leucoagaricus*, in which case the presence of clamp connections in at least some *Leucoagaricus* species must be recognized. The third possibility is that, in spite of Singer's statement that "The separation of *Leucoagaricus* from *Macrolepiota*...is not artificial at all" (1986: 474), this is indeed precisely the case, and our current understanding of segregate generic distinctions within *Lepiota* s. l. is troubled. Because of the peculiarly intricate and baffling phylogeny of this genus sensu lato, this problem may not be solvable on the basis of morphological data alone. Perhaps molecular data will be able at some point to show that indeed one character is more decisive than the other for systematic placement of species such as *L. hortensis*. Hopefully, with further study, a revised, more phylogenetically accurate treatment of this group can be proposed.

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LITERATURE CITED

Akers, B. P. 1992. Peele's Lepiota: an identification and a clarification. Mycotaxon 43: 461-469.

Arora, D. 1986. Mushrooms Demystified. Second edition. Ten Speed Press, Berkeley. 959 pp.

Bon, M. 1981. Cle monographique des "Lepiotes" d'Europe. Doc. Mycol. 11: 1-77.

Candusso, M., and G. Lanzoni. 1990. Lepiota s.l. Fungi Europaei 4. Ed. Giovanna Biella, Saronno. 743 pp.

Dennis, R. W. G. 1952. Lepiota and allied genera in Trinidad, British West Indies. Kew Bull. 7: 459-499.

Franco, A. E. 1994. The genus Lepiota sensu stricto with observations on related taxa in Colombia. Ph.D. Dissertation, City University of New York. 369 pp.

Kelly, K. L., and D. B. Judd. 1965. The ISCC-NBS color name charts illustrated with centroid colors. Supplement to National Bureau of Standards Circular 553.

Largent, D. L., D. Johnson, and R. Watling. 1977. How to Identify Mushrooms to Genus, III: Microscopic Features. Mad River Press, Eureka. 148 pp.

Metzler, S., and V. Metzler. 1992. Texas Mushrooms: A Field Guide. University of Texas Press, Austin. 350 pp.

Murrill, W. A. 1914. Agaricales, Agaricaceae. North Amer. Flora 10: 1-76.

Murrill, W. A. 1943. More new fungi from Florida. Lloydia 6: 220-224.

Murrill, W. A. 1949. Florida Lepiotas. Lloydia 12: 56-61.

Pegler, D. N. 1983. Agaric flora of the Lesser Antilles. Kew Bull. add. ser. IX, Her Majesty's Stat. Off., London. 668 pp. + 27 color plates.

Rodriguez Gallart, C. A. 1990. Estudios en los macromicetos de la Republica Dominicana. II. Moscosoa 6: 202-212.

Singer, R. 1986. The Agaricales in Modern Taxonomy. Fourth edition. J. Cramer, Germany. 912 pp.

Smith, A. H. 1949. Mushrooms in Their Natural Habitats. Sawyers, Portland. 626 pp.

Smith, H. V. 1966. Contributions toward a monograph of the genus Lepiota, I: Type studies in the genus Lepiota. Mycopathol. Mycol. Appl. 29: 97-117.

Weber, N. S., and A. H. Smith. 1985. A Field Guide to Southern Mushrooms. University of Michigan Press, Ann Arbor. 280 pp.

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STUDIES ON THE GENUS INOCYBE IN THE IBERIAN PENINSULA AND BALEARIC ISLANDS. II. INOCYBE CATALAUNICA

by

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Abstract. The holotype of *Inocybe catalaunica* Sing. has been studied. It is concluded that this is the same as *Inocybe subbrunnea* Kühner, this last considered by some authors as conspecific with *Inocybe leiocephala* Stuntz. As *I. catalaunica* was validly described in 1947, it takes nomenclatural priority over the other two taxa.

Resumen. El holótipo de *Inocybe catalaunica* ha sido estudiado; sus caracteres macro y microscópicos han revelado que se trata de la misma especie que *Inocybe subbrunnea* Kühner, considerado este último por algunos autores como coespecífico de *Inocybe leiocephala* Stuntz. *I. catalaunica* es prioritario nomenclaturalmente sobre los otros dos táxones.

In 1934 Rolf Singer visited Catalonia (Spain) and made numerous field studies in the Pyrenees. Unfortunately, it seems that most of the material collected by him during his stay in our country has been either lost or badly damaged for an accurate taxonomic study or revision (Llistosella, pers.comm.).

Of all the list of macromycetes published by him, belonging to this visit (SINGER, 1947), 35 taxa of *Inocybe* (*Cortinariaceae*) were catalogued. Five new taxa of this genus were described: *I. pseudohiulca* subsp. *subduriuscula*, *I. obscura* var. *subpusio*, *I. fastigiata* f. *heimii* (*nom. inval.*), *I. brunnea* f. *insignior* and *I. catalaunica*. All these new taxa were collected in the Pyrenees, mainly from the Valle de Arán (Lleida), in well known localities such as Salardú or Viella (Baricauba Forest), always in montane Abies alba woodlands.

The revision of the genus *Inocybe* in the Iberian Peninsula and Balearic Islands, necessarily has to accomplish the revision of Singer's and Malençon's taxa. Request of information or loan of types to several Herbaria about the Catalonian material was not successfull, except for (LE), the Mycological Herbarium of the Komarov Botanical Institute of the Russian Academy of Sciences in Leningrad. Only *I. catalaunica* could be located, and was kindly sent for its study. The rest of the Catalonian types will probably never be found, and should be considered as nomina dubia.

As the original diagnosis of *I. catalaunica* (SINGER, 1943) is not well known, it is here reproduced again:

Pileo ochraceo-ferrugineo, ad marginem subrimoso, ad centrum subsquamuloso, in siccis subnitente et paullum fibroso, convexo, obtuse umbonato, 20-32 mm. lato. Lamellis argillaceis, dein olivaceobrunneolis, in siccis fuscidulis et acie pallida ornatis, confertis vel subconfertis, sinuato-adnexis, latiusculis. Sporis cum vel sine depressione hilari, amygdaliformi-ellipsoideis, membrana haud crassa, guttula una instructis, melleoflavidis neque intense coloratis sub micr., 8.3-10.3/5-6 µm. Bas. 24-35/7-9 µm, (2-)4-sporis. Cheilocystidiis vesiculoso-clavatis, hyalinis, 25-27/9-14 µm. Cyst. numerosis, membrana hyalina vel flavida, tenui vel ad latera aut contra apicem incrassata (2-2,5 µm), sed ipsa apice tenuitunicata, crystallis hyalinis vel brunneolis sparsis vel interdum numerosis instructis, ampulliformibus (apice plerumque longe cylindracea vel subattenuata, interdum capitato-reincrassata), plerumque angustis, 50-80/11-13,5(-15) µm (plerumque 60-75/11,5-12,5 µm). Cellulis tramae angustis cylindricis (3-5,8 µm), nonnullis vesiculoso-inflatis (usque ad 16 µm). Stipite concolori cum pileo, sed ad basin albo, ad apicem manifeste albopruinoso et cystidioso, pleno vel farcto, subaequali vel ad basin incrassato, 34-55/5-6 mm. Carne albida, in stipite in brunneolum vergente. Odore spermatico.
In Abieteto, Bosc de Baricauba, IX. - Affinis videtur I. atripedi et I. brunneae, ab illa autem basi albo, cystidiis longioribus, odore manifesto et habitatione diversa, haec characteribus superficiei pilei, magnitudine sporarum etlatitudine cystidiorum differt.

The type-material (designated as holotypus!) has been numbered LE 12646, and is accompanied by a label from the Institutum Botanicum Barcinonense. It consists of three basidiomes in regular condition, as they are somewhat mouldy in places, but still a reliable microscopical study can be made.

The macroscopic study of the holotypus reveals a stipe concolorous with the pileus, not bulbous, but somewhat enlarged towards the base, which is white. Under the lens, the pruinosity on the stipe apparently covers about 2/3 of its surface; however, the pruina appears to be collapsed and intermixed with moulds. The 1/3 upper part of the stipe looks strongly pruinose. No cortina can be observed at the margin of the pilei. The microscopic features (Fig. 1) are as follows: Spores 9-11 x 5-6,2 µm, ellipsoid to amygdaliform, with obtuse apex, with suprahilar depression in profile, thin-walled, yellow. Basidia clavate, 4-spored. Pleurocystidia 55-70 x 13-16 µm, typically ventricose, mostly sublageniform to fusiform with attenuate obtuse apex, rarely more or less cylindrical and narrow, thick-walled (-3 µm), not or hardly yellow in NH4OH 10%, with scarce crystals at

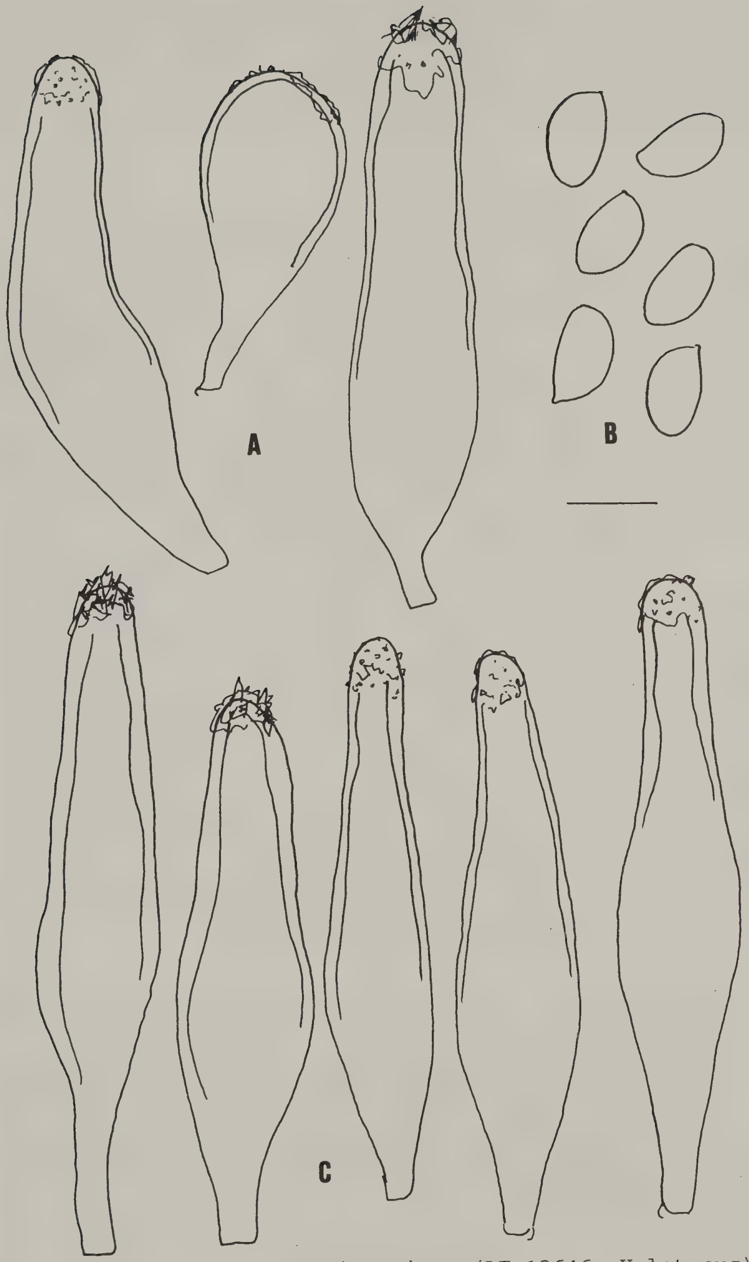

Fig.1.- Inocybe catalaunica Sing. (LE 12646, Holotypus).
A: caulocystidia; B: spores; C: hymenial cystidia. (bar=10 μm)

the apex, some with a collarium of minute crystals. Cheilocystidia similar to pleurocystidia, mixed with numerous paracystidia and clavate cells, probably basidioles. Caulocystidia very frequent in the upper half of the stipe, but mostly collapsed; also caulocystidia present in the lower half, but here dispersed or intermixed with cauloparacystidia, mostly collapsed, practically absent near the base.

The non-bulbose, concolorous stipe, caulocystidia present in the lower half, and other features such as the shape of the cystidia, obtuse spores, size of the basidiomes and ecology fit in most characters *I. subbrunnea* Kühner (KÜHNER, 1955). Though the study of the type of the latter has not been carried out, there can be hardly any doubt that they represent the same species. *I. subbrunnea* was described from *Picea* forests in Praz, Savoie; it seems to be a frequent species in the montane conifer forests of the Alps. *I. catalaunica* was described in a similar ecology, an *Abies* forest from the Pyrenean montane area (1600-1800 m altitude). However, this taxon is also known from *Quercus* or *Pinus* forests in Spain, and seems to be widely distributed. *I. subbrunnea* is also found in the boreo-alpine areas of the European Continent (KÜHNER, 1989; SENN-IRLET & al., 1990), usually recorded on dwarf willows or *Dryas octopetala*.

KUYPER (1986), after the study of the holotype of *I. leiocephala* Stuntz, concludes that *I. leiocephala* and *I. subbrunnea* are conspecific. Judging from Kuhner's very complete description and also that of Stuntz's (in SMITH & STUNTZ, 1950), I agree with Kuyper's opinion, as no deep differences can be found in both original descriptions. His taxonomic treatment is followed here. However, KÜHNER (1988) disagrees with this treatment and considers *I. subbrunnea* a different taxon with a combination of a non-spermatic smell and cystidia with a typical microcrystalline deposit on the top of the metuloids. In Spanish material studied by me and determined as *I.leiocephala=I.subbrunnea* (cf. HEYKOOP & ESTEVE-RAVENTÓS, 1994), I have not been able to support this treatment, as collections with both spermatic smell and typical "subbrunnea metuloids" were found.

I. nitidiuscula (Britz.) Sacc.(=*I. friesii* Heim) differs by the presence of a cortina, and differently coloured stipe with caulocystidia only in the 1/3 apical part. *I. tjallingiorum* Kuyp. (=*I. ovalispora* s. Kühner) differs by the more ovoid and shorter spores and also by the differently shaped cystidia (KUYPER, 1986; STANGL, 1989). On the other side, *I. glabrescens* Velen. (=*I. metrodii* Stangl & J.Veselsky, and possibly the same as *I. abietis* Kühner), differs in differently coloured stipe and narrower, distinctly amygdaliform spores.

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BIBLIOGRAPHICAL REFERENCES

HEYKOOP,M. & ESTEVE-RAVENTÓS,F. (1994) - El género Inocybe (Fr.) Fr., en la provincia de Guadalajara (España Peninsular). *Bol.Soc.Micol.Madrid* **19**:71-86.

KÜHNER,R. (1955) - Compléments à la "Flore Analytique", V. Inocybes leiosporés cystidiés. Espèces nouvelles ou critiques. *Bull.Soc.Nat.Oyonnax* **9** (Mém.hors-sér.**1**):3-95.

KÜHNER,R. (1989) - Fac-similé du Catalogue des Agaricales de la zone alpine du Parc National de la Vanoise et des régions limitrophes. *Doc.Mycol.* **XIX(76)**:31-40.

KUYPER,T.W. (1986) - A revision of the genus Inocybe in Europe. I. Subgenus Inosperma and the smooth-spored species of subgenus Inocybe. *Persoonia suppl.* **3**:1-247.

SENN-IRLET,B., JENSSEN,K.M. & GULDEN,G. (1990). *Arctic and Alpine Fungi - 3.* Soppkonsulenten A/S. Oslo.

SINGER,R. (1947) - Champignons de la Catalogne. Espèces observées en 1934. *Collect.Bot.(Barcelona)* **1**:199-246.

SMITH,A.H. & STUNTZ,D.E. (1950) - New or noteworthy fungi from Mt. Rainier National Park. *Mycologia* **42(1)**:80-134.

STANGL,J. (1989) - Die Gattung Inocybe in Bayern. *Hoppea* **46**:5-388.

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STACHYBOTRYS YUNNANENSIS SP. NOV. AND *NEOSARTORYA DELICATA* SP. NOV. ISOLATED FROM YUNNAN, CHINA

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Abstract

Stachybotrys yunnanensis sp. nov. and *Neosartorya delicata* sp. nov. isolated from Yunnan Province, China are described and illustrated on the basis of morphology and detailed comparative studies.

Introduction

A survey undertaken in Yunnan Province, Southwestern China resulted in the collections of many interesting microfungi which were studied in detail for their systematics and taxonomy. This paper deals with two species of *Stachybotrys* and *Neosartorya*, which proved to be undescribed. These are described as follows with illustrations and Latin diagnoses.

Stachybotrys yunnanensis Kong sp. nov. P1. I

Coloniae in PDA 23-25 mm in diametro in 7 diebus ad 25℃ ; mycelia nivea in coloniis marginalibus, structurae conidicae abundanter fecundae in coloniis centralibus, nigellae; conidiophora e hyphis funicularibus vel aeriis, aliquando e substrato, non ramosa, directa vel exigue curvata, 70-120 × 2.2-4.5 μ m ; phialides obovatae, plerumque 7-10 in verticillo, 8.0-13 × 3.2-5.0 μ m; conidia cylindracea vel subcylindracea, 7.0-11 × (2.5-)3.5-5.0 μ m.

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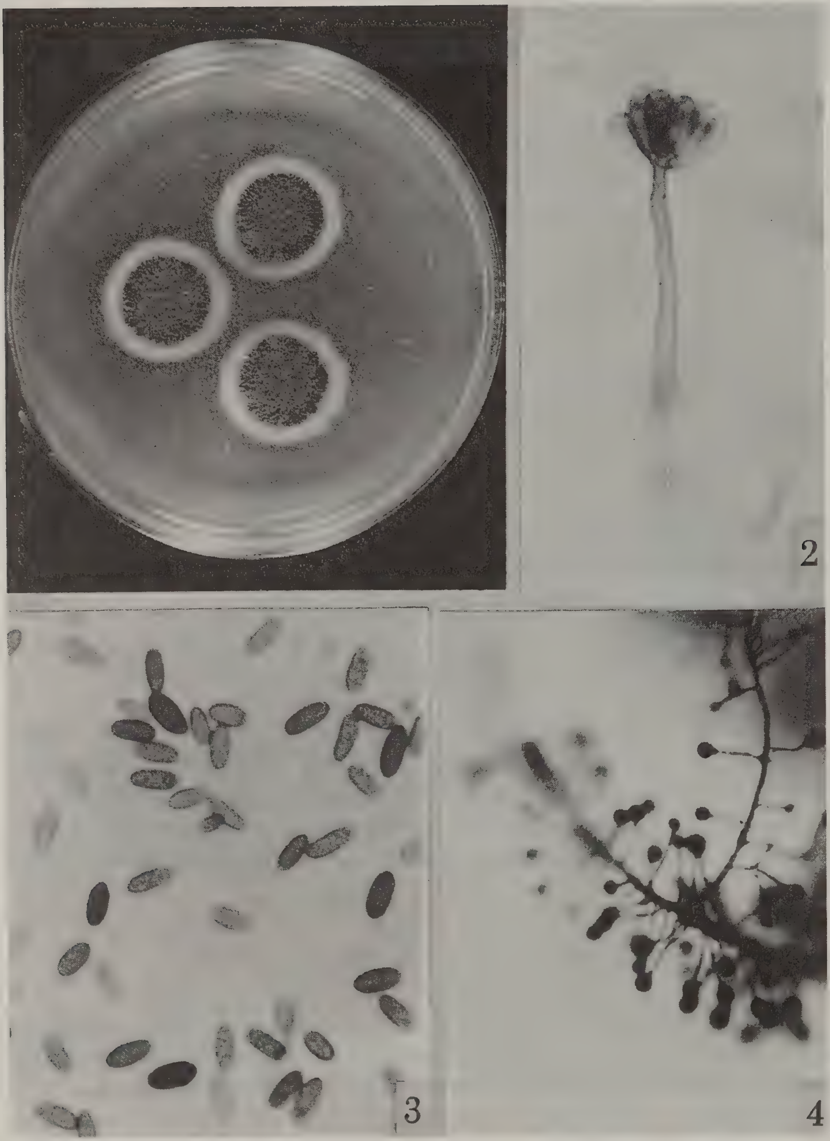


Pl. I *Stachybotrys yunnanensis* Kong: 1. Colonies on PDA in 7 days at 25 ℃ ; 2. Stipe and phialides. × 600; 3. Conidia, × 600; 4. Conidia aggregated in slimy masses, × 94.5

Holotypus HMAS 71158 (cultura viva AS 3.4696) isolatus e charta, Provincia Yunnan Sinica, in Instituto Microbiologico Academiae Sinicae, Beijng, conservatur.

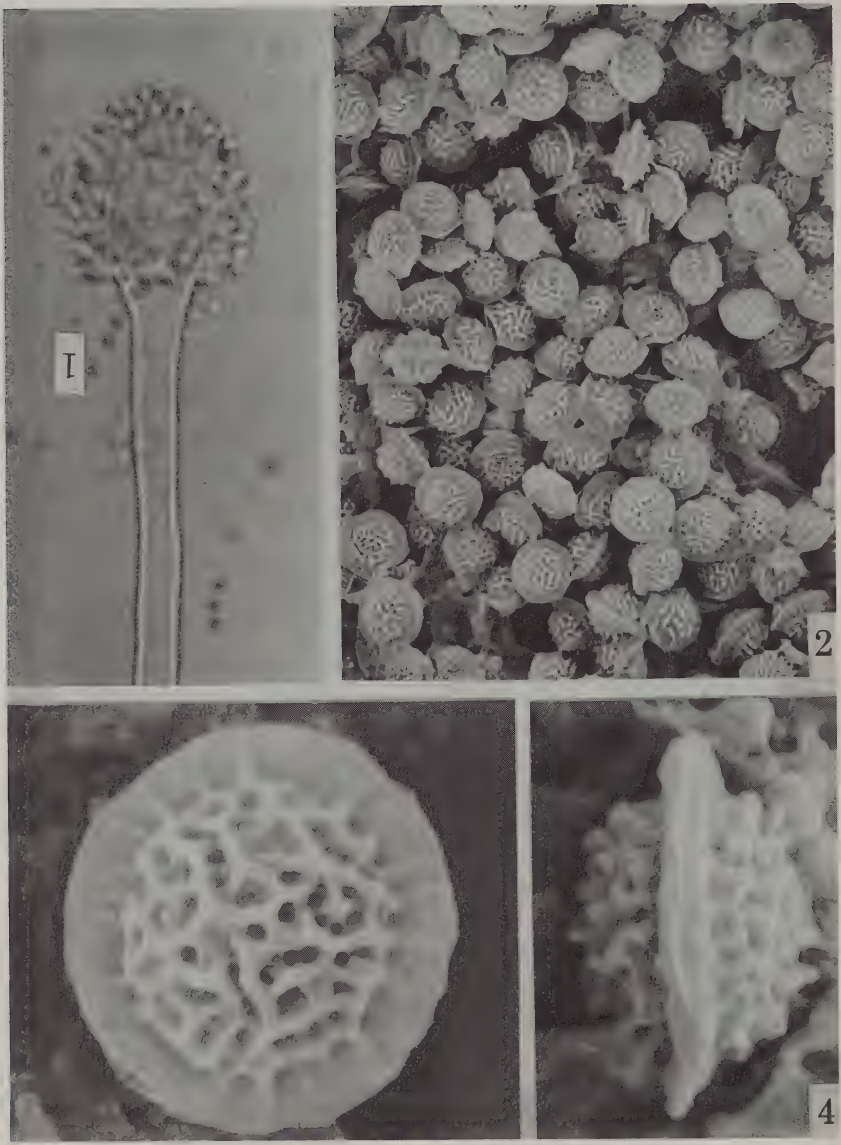
Colonies on PDA growing somewhat restrictedly, attaining a diameter of 23-25 mm in 7 days at 25 ℃ , with surface appearing aerial ropes of hyphae, mycelium white in marginal colony areas, up to 4 mm wide, bearing abundant conidial structures in central areas, conidial areas in blackish shade; reverse in brown-yellow shade; conidiophores arising mainly from funiculose and aerial hyphae, occasionally arising from the substratum, unbranched, straight or slightly curved, greenish becoming gray to black in color, 2-3-septate, usually smooth throughout the length, but sometimes minutely rough-walled at the upper parts, 70-120 × 2.2-4.5 μ m; phialides obovate, usually 7-10 in verticil, 8.0-13 × 3.2-5.0 μ m; conidia cylindrical or subcylindrical, aggregated in slimy masses, at first grayish, but black in age, usually smooth-walled, occationally rough, 7.0-11 × (2.5-)3.5-5.0 μ m.

Colonies on wort agar growing slowly at 25 ℃ , 18-20 mm in diameter at 7 days, floccose-funiculose in appearance, white; no conidial structures observed; reverse purple brown or orange brown.

The present fungus resembles *Stachybotrys breviusculus* McKinzie, but the latter shows marked difference in the branched conidiophores, and smaller and smooth or verrucose conidia. The other one closely resembling species is *S. chartarum* (Ehrenb. ex Link) Hughes, but its conidia are ellipsoidal and smooth-walled or sometimes banded or ridged, moreover, the conidiophores are longer. The species epithet refers to the locality of specimen.

Neosartorya delicata **Kong sp. nov, P1. Ⅱ .**
Stat. anam. ***Aspergillus delicatus*** **Kong sp. nov.**

Coloniae in agaro Czapekii 60-70 mm in diametro in 10 diebus ad 25 ℃ , planae, rarae; sine structuris conidicis observabilibus; cleistothecia abundanter fecunda, leviter flava; sine exsudato; sine odore; cleistothecia globosa vel subglobosa. 200-280 μ m in diametro; asci globosi vel subglobosi, 12-15 μ m in diametro; ascosporae lenticulares cum 2 cristis arcte appressis ad 1.2 μ m latis, 7.0-8.0 × 4.0-5.0 μ m, superficies convexae cum spiculis validis, spicula unita per costas projectas ac ornamenta reticulata formata, ac costae effusae ad cristam; structurae



Pl. Ⅱ . *Neosartorya delicata* Kong: 1. Stipe and vesicle, × 600; 2. Ascospores× 1500; 3.4. Ascospores. × 10000.

conidicae fecundae in pariete tubuli superno ad 37 ℃ ; conidiophora e hyphis praecipue funicularibus vel aeriis, raro e substrato, directa vel sinuosa, stipitibus (100-) 200-350 (-400) × 4.0-8.0 μ m, glabri-tunicatis; capitula laxe conidica; vesiculae ellipsoideae vel fere clavatae, 16-28× 12-20 μ m; phialides 5.0-6.5 × 2.5-3.2 μ m; conidia globosa vel subglobosa, raro ellipsoidea, glabra vel leviter scabra, 2.5-3.0(-4.0) μ m in diametro.

Holotypus HMAS 71159(cultura viva AS 3.4697) isolatus e fructo, Provincia Yunnan Sinica, in Instituto Microbiologico Academiae Sinicae, Beijing, conservatur.

Colonies on Czapek's agar growing rapidly, 60-70 mm in diameter in 10 days at 25 ℃ , plane, thin; no conidial structures observed; cleistothecia abundantly produced, lightly yellow, with colony surface appearing "nealy"; no exudate; odor lacking; reverse in yellowish shades in the central areas, white at marginal and submarginal areas; cleistothecia globose or subglobose, 200-280 μ m in diameter, asci globose or subglobose, 12-15 μ m in diameter, 8-spored; ascospores lenticular, with two equatorial crests appressed closely up to 1.2 μ m wide, convex surface with strong spines, joining one spine to another by fairly prominent ridges and reticulate ornamentation formed, the ridges spreading to the equatorial crest, 7.0-8.0 × 4.0-5.0 μ m; conidial structures produced on the upper end of walls of the slant at 37 ℃ ; conidiophores arising mainly from the funiculose or aerial hyphae, occationally arising from the substratum, stipes (100-) 200-350(-400) × 4.0-8.0 μ m, straight or lightly sinuous, smooth-walled; conidial heads appearing loosely; vesicles ellipsoid or nearly clavate, occationally flask-shaped, fertile over the entire areas or nearly, 16-28 × 12-20 μ m; phialides 5.0-6.5 × 2.5-3.2 μ m; conidia globose or subglobose, rarely ellipsoid, nearly smooth or lightly roughened, 2.5-3.0(-4.0) μ m in diameter.

Colonies on CYA growing rapidly, attaining a diameter of 70-72 mm in 10 days at 25 ℃ , abundantly furrowed in a radial pattern; no conidial structures examined and aeral hyphae limited in number; cleistothecia produced abundantly, lightly yellow; no exudate; odor lacking; reverse yellow-drab.

Colonies on wort agar spreading broadly, attaining a diameter of 70 mm in 7 days at 25 ℃ , plane or nearly plane, no conidial structures examined; cleistothecia produced abundantly, white; no exudate; odor lacking; reverse brown.

Unlike *Neosartorya hiratsukae* Udagawa, Tsubouchi & Horie and *N. fischeri* (Wehmer) Malloch & Cain var. *fischeri*, this species possesses ellipsoid or nearly clavate vesicles, prominent ridges spreading to the equatorial crests, and delicate ornamentation. In addition, it can grow rapidly on Czapek's agar. The specific epithet refers to the character of its ascospores.

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REFERENCES

Jong, S. C. & Davis, E. E. 1976. Contribution to the knowledge of *Stachybotrys* and *Memnoniella* in culture. Mycotaxon 3(3):409-485.

Kozakiewicz, Z. 1989. *Aspergillus* species on stored products. Mycol. Pap.161:1-168.

McKenzi, E. H. C. 1991. Dematiaceous Hyphomycetes on Freycinetia (*Pandanceae*).1. *Stachybotrys*. Mycotaxon 41(1): 179-188.

Muhsin, T. M. & Al-Helfi, M. A. 1981. Hyphomycetes of Iraq-the genus *Satchybotrys*. Sydowia 34:130-134.

Raper, K. B. & Fennell, D. I. 1965. The Genus *Aspergillus*. Williams & Wilkins, Baltimore. 686 pp.

Samson, R. A; Nielsen, P. V. & Frisvad, J. C. 1989. The genus *Neosartorya*: differentiation by scanning electron microscopy and mycotoxin profiles. in Samson, R. A. & Pitt, J. I. (eds). Modern concepts in *Penicillium* and *Aspergillus* classfication. Plenum Press, New York. pp 455-465.

Takada, M. & Udagawa, S. 1985. A new species of heterothallic *Neosartorya*. Mycotaxon 24:395-402.

Takada, M., Udagawa, S. & Norizuke, K. 1986. Isolation of *Neosartorya fennelliae* and interspecific parinings between *N. fennelliae, N. spathulata,* and *Aspergillus fumigatus*. Trans. Mycol. Soc. Japan 27:415-423.

Udagawa, S., Tsubouche, H. & Horie, Y. 1991. *Neosartorya hiratsukae,* a new species of food-borne Ascomycetes. Trans. Mycol. Soc. Japan 32:23-29.

分离于云南的两个新种：云南葡萄穗霉和致密新萨托菌

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摘要: 云南葡萄穗霉(*Stachybotrys yunnanensis* sp. nov.)的菌株分离自思茅的霉纸盒；致密新萨托菌(*Neosartorya delicata* sp. nov.)的菌株分离自西双版纳、中国科学院植物园内发霉的西番莲。经过详细研究和比较其形态特征，发现它们均具独自的特征而分别定为新种。

云南葡萄穗霉类似短葡萄穗霉(*S. breviusculus* McKenzic)，但后者的分生孢子梗分枝，分生孢子较小、壁平滑或有疣等特征而不同于前者；它也和纸葡萄穗霉[*S. chartarum* (Ehrenb. ex Link) Hughes]相近，而后者的分生孢子梗长，分生孢子非圆柱状或近圆柱状、壁平滑、有的呈带状或脊状粗糙，彼此易于区分。

致密新萨托菌，其子囊孢子的网纹非常突出、且很致密，脊延伸至赤道冠，在查氏琼脂上生长迅速，顶囊多为椭圆形或近棒形等特征和近似种平冢新萨托菌(*Neosartorya hiratsukae* Udagawa, Tsubouchi & Horie)及其费希新萨托菌原变种[*N. fischeri* (Wehmer) Malloch & Cain var. *fischeri*]明显不同。

关键词: 云南葡萄穗霉，致密新萨托菌，致密曲霉

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ULTRASTRUCTURE OF BASIDIOSPORES IN NORTH AMERICAN MEMBERS OF THE GENUS *CALVATIA*

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The scanning electron microscope was used for a comparative study of basidiospore morphology in the genus *Calvatia*. Basidiospores of the species *C. pachyderma, C. fumosa, C. sculpta, C. subcretacea, C. gigantea, C. booniana, C. tatrensis, C. depressa, C. craniiformis, C. rubroflava, C. elata, C. cyathiformis*, and *C. bovista* were compared to determine whether the stirp groupings described by Zeller and Smith (1964) extend to spore ornamentation. The surface ornamentation of *Calvatia* spores examined is generally verrucose/echinulate with the exception of *C. pachyderma* which is completely smooth. Correspondence between our data on spore ornamentation and Zeller and Smith's stirpes groupings based on gross morphology was found in *C. craniiformis* and *C. rubroflava* as well as in *C. booniana* and *C. gigantea*. Our results show spore ornamentation, a highly conserved characteristic, can be used to clearly distinguish these species in the genus *Calvatia* and should be used in addition to gross morphology of the sporocarp when classifying them.

INTRODUCTION

Spore ultrastructure plays an important role in the taxonomy of several groups of fungi including the Gasteromycetes (Burk et al., 1983). The electron microscope, and in particular the SEM, provides detailed information on surface ornamentation which aids in taxonomy (Heim & Perreau, 1971; Perreau, 1971; Eckblad, 1971; Hawker, 1971 & 1975; Bronchart et al., 1975; Grand & Moore, 1970). In the genera *Leucophelps* and *Leucogaster*, sporocarp morphology as well as spore ultrastructure shows that these two genera are not related to other genera in the Order Melanogastrales and should be placed in a new Order Leucogastrales with a single family, Leucogastraceae (Fogel, 1979). Ultrastructural features of spores sometimes have been inconclusive in classifying fungi particularly when used independent of other taxonomic characteristics. In a detailed study of spore ultrastructure in five genera of Russulaceae, Pegler & Young (1981) concluded that spore ornamentation cannot be used to determine phylogenetic relationships in the family Russulaceae, because there is too much variance in spore surface morphology to use it as a reliable taxonomic character.

The only comprehensive taxonomic study of genus *Calvatia* classifies species in terms of the gross morphology of the sporocarp but not spore ultrastructure. Zeller & Smith (1964), examining the taxonomic relationships within *Calvatia*, separated species into stirpes. Each stirp represents a "... category for grouping related species when the characters of the groups are integrating to the point of confusion to the taxonomist" (Zeller & Smith, 1964). Thirty two species of *Calvatia* were categorized into seven stirpes on the basis of peridial structure, capillitium structure, and spore shape. Recent research in *Calvatia* indicates spore ultrastructure should be included along with the other taxonomic characters; however, species groupings should not be based entirely on spore ultrastructure since this as well as other taxonomic characters have been shown to vary even within a species. For example, selected species of *Calvatia* collected in the alpine and arctic tundra did not have the same combination of characteristics described previously for these taxa (Miller et al., 1980). Previously reported differences in spore ornamentation as well as capillitium structure in these species was due to the maturity of the spores and variation in weather respectively (Miller, 1980).

Recently one of us, examining spore morphology and allergenic properties of *C. cyathiformis*, *C. rubroflava*, *C. craniiformis*, and *C. gigantea*, showed each species could be identified according to its unique surface ornamentation and, in the case of *C. rubroflava*, *C. craniiformis*, and *C. cyathiformis*, according to protein composition and/or allergenicity (Levetin et al., 1992). The current study was undertaken to examine the spore ultrastructure of selected species in the genus *Calvatia* and the taxonomic relationship of these species based on spore ornamentation.

METHODS AND MATERIALS

Basidiospore samples from thirteen species of *Calvatia* were examined with the scanning electron microscope in order to compare spore morphology and surface ornamentation (Table 1). Nine of the thirteen *Calvatia* puffball samples were obtained from the herbarium at the University of Michigan. Three species, *C. cyathiformus*, *C. craniiformis*, and *C. rubroflava*, were collected from local fields. A sample of *Calvatia gigantea* spores was obtained from Minnesota. Voucher specimens of local species are found in the Barclay Herbarium at The University of Tulsa.

The surface ornamentation of basidiospores from each species of *Calvatia* was examined initially by light microscopy. Spores were mounted with water or Melzer's Reagent and then viewed at 1000x under both bright field and phase contrast conditions. Spore size range was determined from the measurements of at least 10 spores selected from different fields.

For SEM, a cube of Tempfix (approx. 0.5 mm on each side) was placed onto an aluminium stub and melted in an oven at 120^{o} C. The stub was removed from the oven and the tempfix spread into a thin film before allowing it to cool. Dried basidiospores were spread on the stub and subsequently heated in the oven at 45^{o} C to attach them to the stub. Basidiospore samples were then sputter coated with gold in an Emscope SC500A sputter coater and later viewed with an Hitachi S-2300 SEM. All micrographs were taken at 15,000x and are shown here at a final magnification of x10,950.

RESULTS AND DISCUSSION

Thirteen species of the genus *Calvatia* were examined with respect to spore morphology and ornamentation. The light microscope revealed distinct surface ornaments in seven of the thirteen species including: *C. cyathiformis, C. fumosa, C. sculpta, C. depressa, C. elata, C. craniiformis, and C. rubroflava.* The scanning electron micrographs clearly demonstrate differences in spore surface structure between all thirteen species, some of which have been characterized previously only by light microscopy (Zeller & Smith, 1964). Species can be distinguished from each other on the basis of spore shape, spore size, and shape/length of surface ornaments (Table 2).

Table 1. *CALVATIA* SPECIES INCLUDED IN THIS STUDY

Species	Stirps
C. pachyderma (Peck) Morgan (U of Mich. Herbarium # Rea H230)	Pachyderma
C. fumosa Zeller (U of Mich. Herbarium # Smith 64963)	Pachyderma
C. sculpta (Hark.) Lloyd (U of Mich. Herbarium # Rea H1186)	Sculpta
C. subcretacea Zeller (U of Mich. Herbarium # Smith 58781)	Sculpta
C. booniana Smith (U of Mich. Herbarium # Trueblood 4229)	Gigantea
C. tatrensis Hollos (U of Mich. Herbarium # Trueblood 1971)	Tatrensis
C. depressa (Bon.) Zeller & Smith (U of Mich. Herbarium # Smith 55617)	Tatrensis
C. elata (Massee) Morgan (U of Mich. Herbarium # Kaufman 1907)	Craniiformis
C. bovista (Pers.) Kambly & Lee (U of Mich. Herbarium # Smith 66484)	Bovista
C. cyathiformis (Bose) Morgan*	Cyathiformis
C. craniiformis (Schw.) Fries*	Craniiformis
C. rubroflava (Cragin) Morgan*	Craniiformis
C. gigantea (Batsch ex Pers.) Lloyd**	Gigantea

* Voucher specimens in the Barclay Herbarium at The University of Tulsa
** Spores provided by John Geens, Rochester, Minnesota

Although our measurements and shape descriptions of *Calvatia* spores are consistent with previous data (Table 2 and Zeller & Smith, 1964), the improved resolution of the SEM allows a precise description and comparison of surface structure between different species. The following spore descriptions are based on SEM examination:

> Basidiospores of *C. pachyderma* shown here have a smooth texture (Fig. 1) even though previous SEM studies show conflicting evidence of *C. pachyderma* spores having either verrucose ornamentation (Kreisel, 1989; "faintly punctate", Zeller & Smith, 1964) or no surface ornamentation (Demoulin et al., 1988).
>
> *Calvatia fumosa* spores have verrucose appendages distributed unevenly on a course spore surface (Fig. 2), consistent with spore ultrastructure for *C. fumosa* spores reported previously (Kreisel, 1989).
>
> *Calvatia rubroflava* has slender echinulate ornaments, ~0.8 µm in length, spaced evenly on the spore surface; each appendage may be interconnected at its base to adjacent ornaments by slightly elevated ridges (Fig. 3).
>
> *Calvatia subcretacea* spores have numerous verrucae, each less than 0.5 µm in length, distributed unevenly, sometimes in small clusters, over a rough spore surface (Fig. 4).

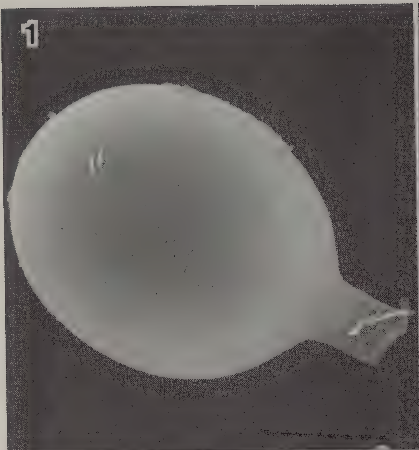
Table 2. SPORE ORNAMENTATION IN SELECTED SPECIES OF *CALVATIA*

Species	Size Range and Shape of Spore	Ornamentation	Ornament Length (μm)
C. pachyderma	2.1-3.5x2.8-3.8 μm subglobose-elliptical	-------	----
C. fumosa	3.8-5.9 μm globose	verrucose	0.51
C. rubroflava	2.5-3.9 μm globose	echinulate	0.83
C. subcretacea	3.5-4.5 μm globose	verruculose	0.39
C. gigantea	3.1-4.2 μm subglobose	verrucose	0.48
C. booniana	3.4-3.9 μm subglobose	verrucose	0.54
C. depressa	2.5-2.8 μm globose	verrucose	0.66
C. tatrensis	3.4-4.9 μm globose	verruculose	0.21
C. sculpta	2.0-2.8 μm globose	echinulate	0.95
C. elata	2.1-3.5 μm globose	verrucose	0.96
C. bovista	2.1-3.5 x 2.8-3.8 μm subglobose-elliptical	rugulose	0.20
C. craniiformis	2.5-3.4 μm globose	verrucose	0.48
C. cyathiformis	4.6-5.2 μm globose	verrucose	1.85

The spore surface of *C. gigantea* has a few irregularly shaped warts consistent with the observations for *Langermannia gigantea* (Fig. 5; Perreau, 1971).

Spores for *C. booniana* have verrucose ornaments similar to that observed for *C. gigantea*; however, the appendages of *C. booniana* spores demonstrate a greater range of shape and size with larger ornaments having a segmented globular shape (Fig. 6).

FIGURE LEGENDS: Fig. 1.- *Calvatia pachyderma.* Basidiospore is subglobose-elliptical, 3.33 x 4 μm in size, and completely smooth. Fig. 2.- *Calvatia fumosa.* Globose spore is 3.8 μm in diameter, with short blunt tipped ornaments on a rough surface. Fig. 3.- *Calvatia rubroflava.* Spore is globose and 3.7 μm in diameter. Ornaments are echinulate with rounded tips. Fig. 4.- *Calvatia subcretacea.* Globose basidiospore, 3.7 μm in diameter, covered with short warty ornaments. Fig. 5. - *Calvatia gigantea.* Subglobose spore, 3.0 x 3.3 μm in size, has irregular ornaments of uneven lengths. Fig. 6.- *Calvatia booniana.* Basidiospore is subglobose-globose, 3.5 x 3.7 μm in size with irregularly shaped ornaments of uneven size and height.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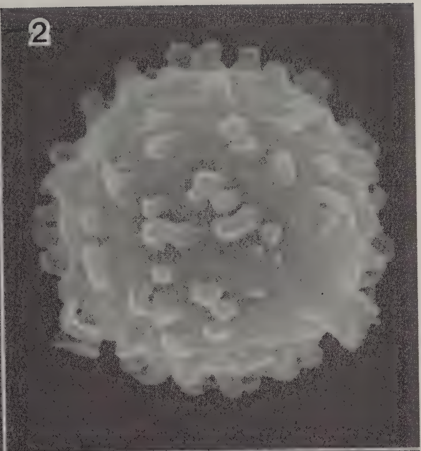
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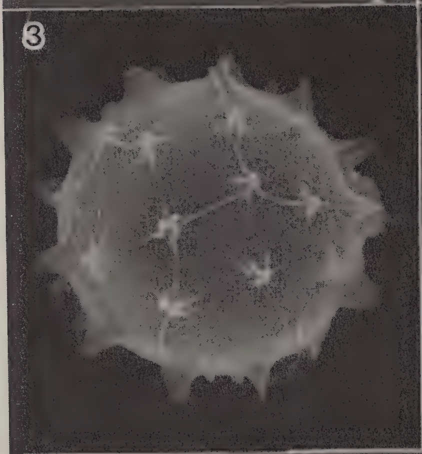
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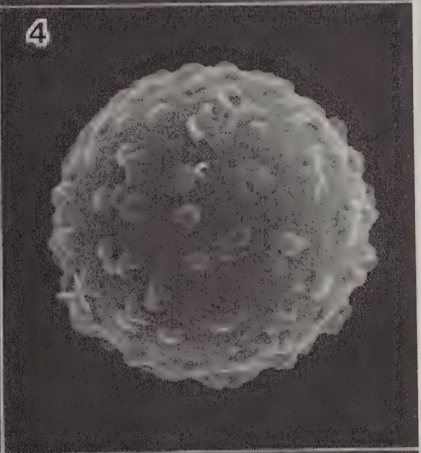
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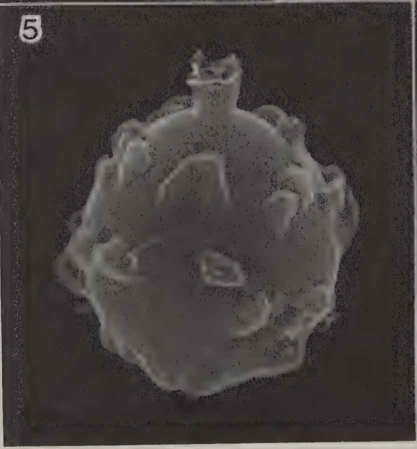
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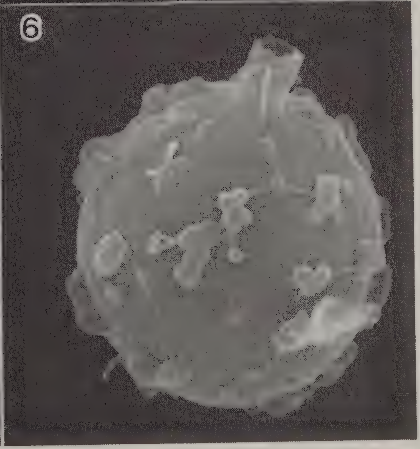
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Calvatia depressa spores have evenly spaced, verrucose ornaments which are slightly truncated their tips giving each ornament a pointed angle between 30-45 degrees (Fig.7).

Calvatia tatrensis spores have small wart-like, i.e., verruculose, appendages evenly distributed over the spore surface (Fig. 8), whereas *C. tatrensis* spores were previously reported to have prominent verrucose ornaments (Miller et al., 1980).

Basidiospores of *C. sculpta* have large verrucose ornaments of variable size with pointed tips (Fig. 9).

Calvatia elata spores have blunt tipped verrucose ornaments ~1 µm in length, some of which have branched trunks with multiple sites of attachment on the spore surface (Fig. 10).

Calvatia bovista spores are covered with short wart-like ornamentation almost indistinguishable from the background surface texture (Fig. 11).

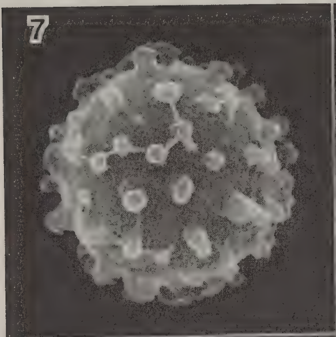
Spores of *C. craniiformis* have slightly tapered verrucose ornaments, almost 0.5 µm in length, which are more or less equidistant from each other (Fig. 12).

Large *C. cyathiformis* spores have peltate verrucose ornaments, approaching 2 µm in length, frequently joined by raised connectives (Fig. 13, Levetin et al., 1992). *Calvatia cyathiformis* was previously described as *C. lilacum*, with round verrucose ornaments without prominent connectives (Heim & Perreau, 1971).

The thirteen species of *Calvatia* examined here are generally globose-to-subglobose in shape with verrucose ornamentation. The spore ultrastructure supports tentative taxonomic groupings for *C. craniiformis* and *C. rubroflava* as well as *C. booniana* and *C. gigantea* consistent with the stirp groupings of Zeller & Smith (1964). Further classification or grouping of species based on spore structure will depend, at the very least, on SEM examination of all remaining species in the genus *Calvatia*. Based on the variation in surface texture and ornamentation between species observed here, the subgrouping of species within the genus *Calvatia* will probably depend on other taxonomic characters which are less variable than spore surface structure.

The distinctiveness of spore ultrastructure is useful in the delimitation of species within *Calvatia* and related genera, particularly, when uncertainty exists about species identity based on limited or incomplete information within a collection. Zeller & Smith (1964) describe spores of *Calvatia pachyderma* as "finely warted to seemingly smooth,"

FIGURE LEGENDS: Fig. 7.-*Calvatia depressa.* Basidiospore is globose and 2.6 µm in diameter. Warty ornaments are apically covered with low conical caps. Fig. 8.- *Calvatia tatrensis.* Spore is globose 3.6 µm in diameter with short verruculose ornaments distributed in punctate fashion. Fig. 9.-*Calvatia sculpta.* Globose spore is 2.7 µm in diameter, with verruose to echinulate ornaments of uneven lengths. Fig. 10.- *Calvatia elata.* Basidiospore is 3.5 µm in diameter and globose. Large verrucose ornaments are blunt tipped with some having multiple sites of attachment. Fig. 11.- *Calvatia bovista.* The subglobose to elliptical spore is 2.8 µm in diameter and has small warty elevations of variable size almost indistinguishable from the course surface. Fig. 12.- *Calvatia craniiformis.* Basidiospore is 3.0 µm in diameter. The echinulate/verrucose ornaments have variable tips, some are pointed and others are rounded. Fig. 13.- *Calvatia cyathiformis.* Globose spore is 4.5 µm in diameter with slender petate verrucose appendages interconnected by ridge-like extensions.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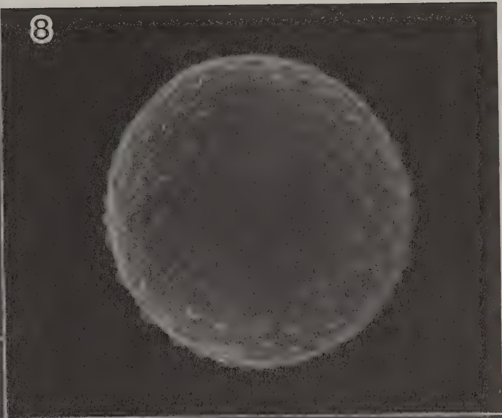
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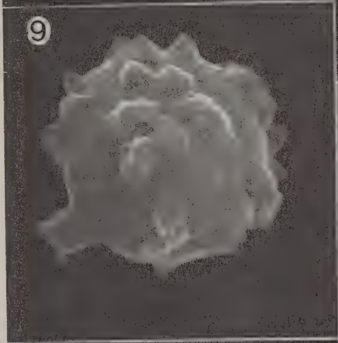
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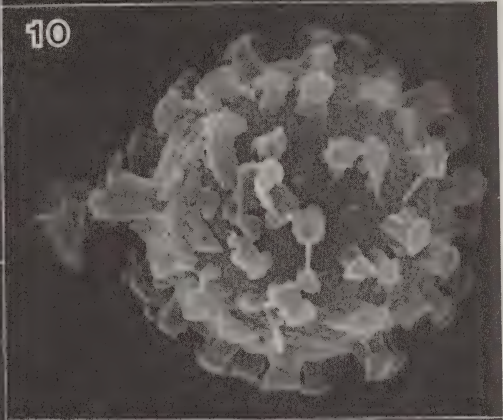
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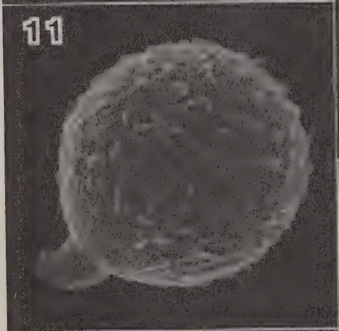
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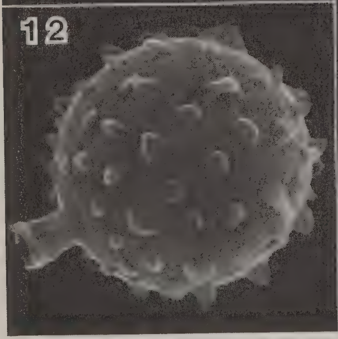
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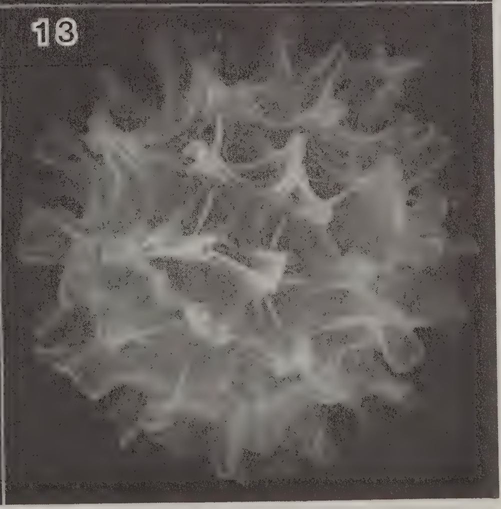
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whereas the spores of *C. pachyderma* described here and elsewhere (Wright, 1990; Demoulin et al., 1988; Demoulin, 1993) are smooth and devoid of ornamentation. A recent summary of evidence on the "*Calvatia pachyderma*" complex indicates the smooth ovoid spores belong to *Gastropila fragilis*, while the verruculose, globose to subglobose spores belong to a closely related species *Langermannia pachyderma* (Calonge & Martin, 1990). In a parallel situation, verrucose spores identified as belonging to a type collection of *Lycoperdon pachydermum* Peck by Calonge and Martin (1990) are now known to represent a contamination and, in fact, belong to *C. booniana* (Demoulin, 1993). Thus, a careful ultrastructural evaluation of a puffball and, in particular, its attached spore type can be conclusive in determining species identity.

Miller et al. (1980) suggested that extreme climate can affect both spore appearance and maturation so that spore ultrastructure must be used with care in species identification. In studying several arctic species of *Calvatia*, among them *C. artica, C. borealis, C. tatrensis*, and *C. tatrensis var. groenlandica*, these researchers concluded, primarily on microscopic observations of the "unique dextrinoid reaction of the endoperidium, similar morphology of connivant fibrils, spores, and capillitium," that these species belong to one taxon, *C. cretacea*. Previously reported differences in spore ornamentation between these specimens were due to differences in the maturity of puffball samples. In contrast, a later study of 10 arctic and subarctic species of *Calvatia*, including the three species above, concluded that each species can be identified with respect to its "original structure" if the fruiting body is examined at the correct stage in development, with taxonomic emphasis given to the structure of the peridium, color of the gleba, color of the capillitium and color of spore (Lange & Demoulin, 1993). Therefore, in conjunction with other taxonomic characters, spore ultrastructure can identify a species if the fruiting body is examined in the correct stage of maturation.

Since spore morphology appeared uniform and consistent within each species described here, spore ultrastructure may be a highly conserved trait and, therefore, probably under tight nuclear control even during development (Grand & Moore, 1970). Preliminary TEM data from thin sections of *C. cyathiformis* spores, collected over regular intervals from drying puffballs, showed spores have a full complement of surface ornaments during maturation and only the shape and length of individual ornaments change before spores are released from the puffball (unpublished data, Moseman & Levetin, 1992). Recently spore samples from five species of basidiomycetes and one species of myxomycetes examined by flow cytometry indicated each species could be separated, even in a sample mixture, according to size and surface morphology consistent with spore ultrastructure (Allman, 1992). In the future, biochemical analysis of spore extracts (Ibanez et al., 1988) or identification of certain enzyme markers/proteins on spores (Elisashvili et al., 1992) or genetic markers may be used in conjunction with spore morphology to distinguish and identify species within a genus.

LITERATURE CITED

Allman, R. 1992. Characterisation of fungal spores using flow cytometry. Mycol. Res. 96(12):1016-1018.

Bronchart, R., Calonge, F.D., and Demoulin, V. 1975. Nouvelle Contribution a L'etude de L'ultrastructure de la Paroi Sporale des Gasteromycetes. Bull. Soc. Mycol. France. 91(2):231-246.

Burk, W.R., Flegler, S.L., and Hess, W.M. 1983. A Review of Ultrastructural Studies of Gasteromycete Spores. Revista Biol. (Lisboa) 12:217-230.

Calonge, F.D., and Martin, M.P. 1990. Notes on the Taxonomical Delimitation in the Genera *Calvatia*, *Gastropila* and *Langermannia* (Gasteromycetes). Bol. Soc. Micol. Madrid 14:181-190.

Demoulin, V. 1993. *Calvatia pachyderma* (Peck) Morg. and *Gastropila fragilis* (Lev.) Homrich et Wright, two possible names for the same fungus. Mycotaxon 46:77-84.

Demoulin, V., Martin, M.P., and Calonge, F.D. 1988. *Calvatia pachyderma* (Peck) Morgan (Gasteromycetes), Nueva Para Europa. Bol. Soc. Micol. Madrid 12:85-88

Eckblad, F-E. 1971. Spores of Gasteromycetes Studied in the Scanning Electron Microscope (SEM) I. Norw. J. Bot. 18:145-151.

Elisashvili, V.I., Glonti, N.M., Kachlishvili, E.T., Kiknadze, M.O., and Tusishvili, Kh.A. 1992. Screening of Higher Basidiomycetes -- protein and enzyme producers. Prikl. Biokhim. Mikrobiol. 28(3):362-366

Fogel, R. 1979. The Genus *Leucophelps* (Basidiomycotina, Leucogastrales). Can. J. Bot. 57: 1718-1728.

Grand, L.F. and Moore, R.T., 1970. Ultracytotaxonomy of Basidiomycetes. I. Scanning Electron Microscopy of Spores. J. Elisha Mitchell Sci. Soc. 86: 106-117.

Hawker, L.E. 1971. Scanning Electron Microscopy of Fungi and its Bearing on Classification. In Heywood, V.H. (ed.) Scanning Electron Microscopy: Systematic and Evolutionary Applications. London, Academic Press. pp. 237-249.

Hawker, L.E. 1975. Scanning Electron Microscopy of Basidiospores as an Indication of Relationships among Hypogeous Gasteromycetes. Beih. Nova Hedwig. 51:123-132.

Heim, R. and Perreau, J. 1971. Etude Ornementale de Basidiospores au Microscope Electronique a Balayage. In Scanning Electron Microscopy: Systematic and Evolutionary Applications. London, Academic Press. pp. 251-284.

Ibanez, M.D., Horner, W.E., Liengswangwong, V., Sastre, J., and Lehrer, S.B. 1988. Identification and Analysis of Basidiospore Allergens from Puffballs. J. Allergy Clin. Immunol. 82(5):787-795.

Kreisel, H. 1989. Studies in the *Calvatia* Complex (Basidiomycotina). Nova Hedwigia 48(3-4):281-296.

Lange, M. 1990. Arctic Gasteromycetes II. *Calvatia* in Greenland, Svalbard and Iceland. Nordic J. Bot. 9:525-546.

Levetin, E., Horner, W.E., and Lehrer, S.B. 1992. Morphology and Allergenic Properties of Spores From Four *Calvatia* Species. Mycologia. 84(5):759-767.

Miller, O.K., Burdsall, H.H., Laursen, G.A., and Sachs, I.B. 1980. The Status of *Calvatia cretacea* in Arctic and Alpine Tundra. Canad. J. Bot. 58:2533-2542.

Pegler, D. N., and Young, T.W.K. 1981. Russulaceae Roze. World Pollen and Spore Flora 10:1-35.

Perreau, J. 1971. L'ornementation Sporale chez les Lycoperdons. Ann. Sci. Nat. Bot. Biol. Veg. 12(12):127-145.

Wright, J.E. 1990. *Calvatia pachyderma* (Peck) Morgan is *Gastropila fragilis* (Lev) Homrich & Wright. Mycotaxon 37:187-189.

Zeller, S.M. and Smith, A.H. 1964. The Genus *Calvatia* in North America. Lloydia. 27: 148-186.

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GLASSY-HAIRED HYALOSCYPHACEAE: NEW TAXA AND NEW SYNONYMIES

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Abstract

Four new taxa are described in the glassy-haired Hyaloscyphaceae. *Hyalopeziza echinatula* Raitv. & Huhtinen is a *Cistella*-like, graminicolous species with cyanophilous spines on the glassy hairs. *Hyalopeziza racemosa* Raitv. & Huhtinen is a herbicolous species with branched hairs on the flanks. *Hyalopeziza cadaverina* Huhtinen & Raitv. is a wood-inhabiting species bearing resemblance to the genus *Protounguicularia* Raitv. & Galán. *Urceolella peleana* Huhtinen & Raitv. is a corticolous species related to *U. pani* (Velen.) Huhtinen. *Hyalopeziza arctica* Raitv. is synonymized with *H. raripila* (Höhn.) Huhtinen. *Hyalopeziza schachdarica* Raitv. and *H. archangelica* Olsen & Sivertsen are shown to be conspecific with *H. latispora* Raitv. Many of the taxa discussed are arcto-alpine in distribution.

Key words: *Hyalopeziza, Urceolella,* Hyaloscyphaceae, taxonomy, new species, arcto-alpine distribution

Introduction

In the glassy-haired Hyaloscyphaceae easily observable and markedly prominent characters do occur. Nevertheless, these characteristics do not yet allow us to arrange the known species into well-defined genera. Starting from Raitviir's (1970) treatise which accepted a broad concept of *Hyalopeziza* Fuckel, many solutions have been sought (e.g. Raschle 1977, Korf & Kohn 1980, Raitviir & Galán 1986, Svrček 1986, Huhtinen 1987a, 1987b, 1987c, 1987d, 1987e, Svrček 1987, Zhuang 1988, Baral 1993, Raitviir & Galán 1993). In the present paper the authors merely concentrate on describing the taxa, not on the generic jungle. Personally we feel that little serious progress can be made concerning the generic limits in the glassy-haired Hyaloscyphaceae until further taxa become known. Even the few new taxa described here, revealed character combinations which seem to upset the prevailing generic limits.

The following abbreviations are used: CB (cotton blue in lactic acid), CR (ammoniacal Congo red) and MLZ (Melzer's reagent). All studies were made on dry herbarium specimens.

Taxonomy

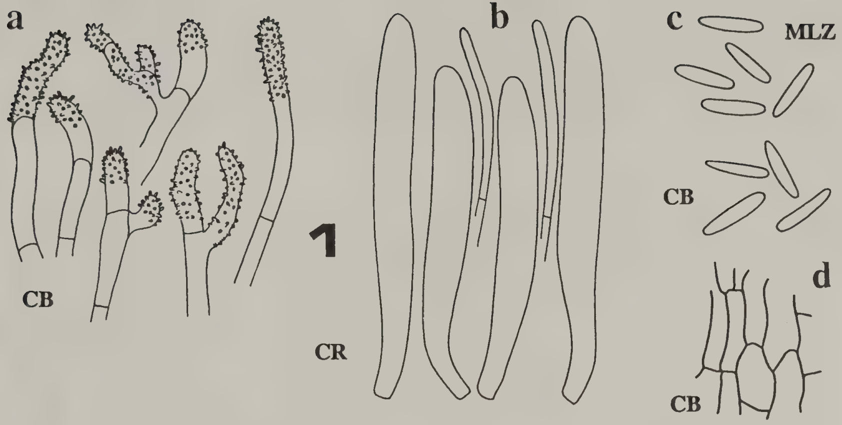
Hyalopeziza echinatula Raitv. & Huhtinen, sp. nov. – Fig 1

Apothecia sessilia vel subsessilia, ad usque 0.3 mm in diametro, cupulata, pallide lutea vel pallide ochracea, margine minute puberula. Excipulum ectale ex cellulis prismaticis hyalinis compositur. Pili cylindracei, interdum ramosi, 26–38 x 2.5–4.0 µm, basi tenuiter tunicatis, apicibus permanente solide vitreis. Asci cylindracei vel cylindraceo-clavati, octospori, uncinati, poro iodo coerulescentia, 53–63 x 6.0–7.0 µm. Sporae cylindraceo-ellipsoideae, saepe subfusoideae, inequilateralia vel suballantoideae, hyalinae, aseptatae, 8.8–11.8 x 1.8–2.2 µm. Paraphyses filiformes, ascos non superantes, 1.0–1.5 µm in diam.

Holotypus: ad gramina sicca, Tadjikistan, Pamiro-Alai, Montes Peter I, Langar, 2000 m alt., 21.06.1979 M. Raitviir (TAA-117116).

Apothecia gregarious to scattered, superficial, sessile to subsessile. Disc up to 300 µm in diam., pale yellowish to pale ochraceous when dry. Receptacle cupulate, concolorous with the hymenium, at the margin minutely downy. Ectal excipulum composed of hyaline, thin-walled, elongated-prismatic cells measuring 10–14 x 2.5–6.0 µm, walls remaining hyaline in MLZ and CR, but deep cyanophilous in CB. Hairs cylindrical with obtusely rounded tip, 0-1 -septate, sometimes forked (10–15 %), hyaline, measuring 26–38 x 2.5–4.0 µm, with thin walls in basal part and solid glassy apex lacking lumen, not losing refractiveness in KOH even after heating in 10 % solution, remaining hyaline in MLZ but glassy material staining red in CR, covered in upper parts by hyaline, cyanophilous spines, up to 1.6 µm high, spines remaining unchanged in KOH, MLZ and CR; only 5–10 % of the hairs have no solidifications. Asci cylindrical to cylindric-clavate, arising from croziers, eight-spored, apical pore blue in MLZ, measuring 53–63 x 6.0–7.0 µm in CR (x = 58 x 6.6 µm, n=10).

Figs. 1–2. *Hyalopeziza echinatula* and *Hyalopeziza cadaverina,* scale 50 µm, for apothecia 100 µm. – Fig. 1. Holotype of *H. echinatula* a) marginal hairs b) asci and paraphyses c) ascospores d) ectal excipulum from medial flank area – Fig. 2. Holotype of *H. cadaverina* a) marginal hairs b) detail from margin c) dry apothecia d) ascospores e) asci and paraphyses f) ectal excipulum from medial flank area g) ectal excipulum below the marginal hairs.



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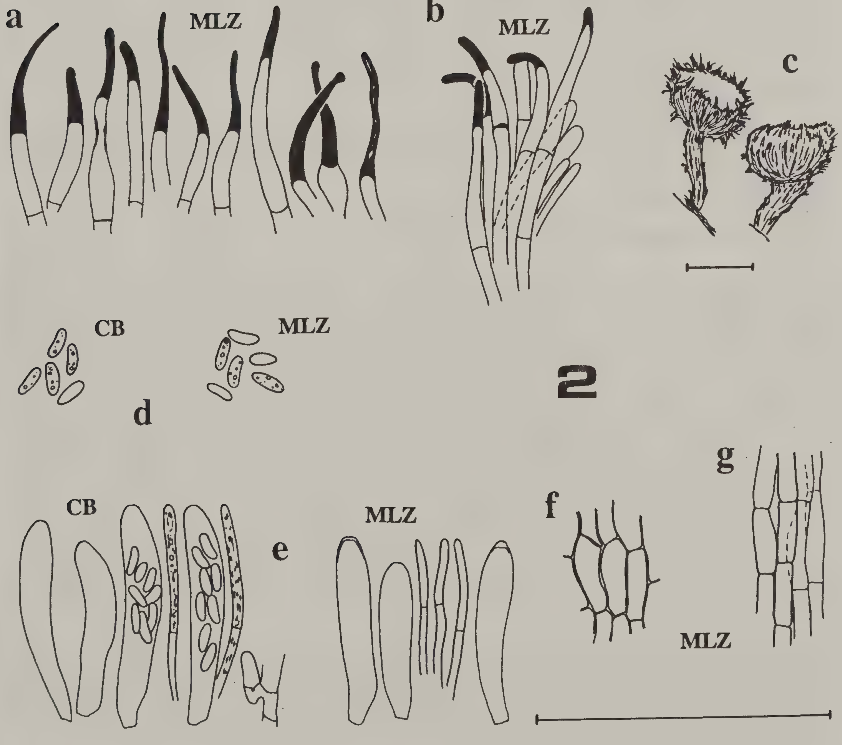

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Ascospores cylindric-ellipsoid, sometimes subfusoid, inequilateral to slightly allantoid, hyaline, aseptate, aguttulate or indistinctly 1-guttulate in CB, measuring 8.8–11.8 x 1.8–2.2 µm in CB (x = 10.6 x 2.0 µm, n=10). Paraphyses filiform, rarely branching in basal part, obtuse, not exceeding the asci, 1.0–1.5 µm in diam.

Holotype: on dead grass culms, Tadjikistan, Pamiro-Alai Mountains, the Peter the 1st Range, Langar, ca. 2000 m a.s.l, 21.06.1979 M. Raitviir (TAA–117116).

This curious species could seemingly be classified either as a glassy-haired *Cistella* Quel. or as an exceptional *Hyalopeziza.* Warted hairs are known in *H. pygmaea* (Mouton) Huhtinen, but the warts are different in structure to those of the present species. In *H. pygmaea* the hairs are covered by low, roundish, cyanophilous warts (Huhtinen 1987a). In the present species hair vesture is identical to that found in *Cistella* subg. *Verrucotricha* Matheis (Matheis 1977). The hairs in *H. echinatula* resemble closely also in size and shape those of certain *Cistella* species. Some hairs are exactly like those of *Cistella,* as they lack any traces of glassy material. Excipular and hymenial characters fit both *Cistella* and *Hyalopeziza.* On the other hand, the cyanophilous spines do not necessarily link the present species to *Cistella* subg. *Verrucotricha,* as similar spines are also seen elsewhere in the Hyaloscyphaceae, at least in *Polaroscyphus* Huhtinen (1987d).

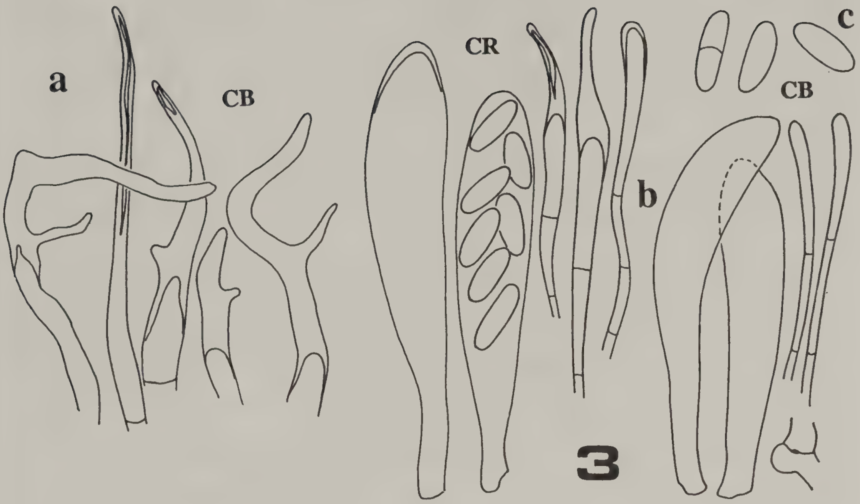
The type material is relatively scanty, and a very thorough study cannot be made. As a provisionary solution the present taxon is placed in *Hyalopeziza.*

Hyalopeziza racemosa Raitv. & Huhtinen sp. nov. – Figs. 3–4

Apothecia sessilia, ad usque 0.3 mm in diametro, cupulata, albida vel pallide ochracea, extus breviter pilosa. Excipulum ectale ex cellulis prismaticis hyalinis compositur. Pili cylindracei, ramosi vel racemosi, 35–68 x 4–6 µm, basi tenuiter tunicatis, apicibus permanente solide vitreis. Asci late clavati, octospori, uncinati, poro iodo coerulescentia, 54–96 x 8.5–11.5 µm. Sporae ellipsoideae vel cylindraceo-ellipsoideae, minute inequilateralia, hyalinae, aseptatae vel uniseptatae, 10.2–14.2 x 3.2–4.5 µm. Paraphyses filiformes, 1.5–2 µm in diametro, apicibus subclavatis, 3.0 µm in diametro, vel vitreis, 5.0 µm in diametro.

Holotypus: ad caules emortuis herbarum, Tadjikistan, Pamiro-Alai, Montes Darvaz, Passe Haburabat, 3050 m alt., 24.06.1982 A. Raitviir (TAA–64958).

Figs. 3–4. *Hyalopeziza racemosa,* scale 50 µm, for apothecia 200 µm. – Fig. 3. Holotype a) marginal hairs b) asci and paraphyses c) ascospores – Fig. 4. Paratype a) asci and paraphyses b) ascospores c) ectal excipulum from medial flank area d) dry apothecia e) marginal hairs.



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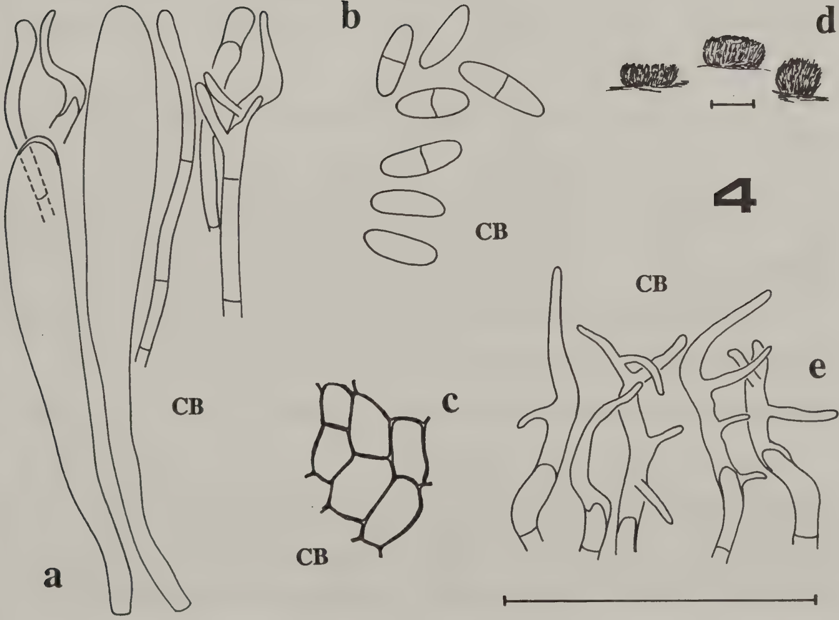

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Apothecia gregarious, superficial, sessile. Disc up to 300 µm in diam., whitish to pale ochraceous when dry. Receptacle cupulate, concolorous with the hymenium, densely covered with short whitish hairs. Ectal excipulum composed of hyaline, thin-walled, prismatic cells, measuring 8–12 x 5.0–7.5 µm (Q = 1.6), remaining hyaline in MLZ, CB, CR. Hairs cylindric-conical with rounded tips, simple, branched to horn-shaped, aseptate, hyaline, 35–60 x 4–6 µm, with thin basal walls and solid, glassy apex, with or without a narrow lumen, refractiveness partly lost in KOH but hair structure stable even after repeated heatings in KOH, marginal hairs typically unbranched and more or less straight, flank hairs typically strongly branched, curved and flexuous. Asci broadly clavate, arising from croziers, apical pore blue in MLZ only after KOH-pretreatment, eight-spored, 54–96 x 8.5–11.5 µm in CB, MLZ (x = 73.7 x 10.4 µm, n = 10). Ascospores ellipsoid to broadly cylindric-ellipsoid, slightly inequilateral, hyaline, aseptate to sparsely 1-septate, aguttulate in CB, measuring 10.2–14.2 x 3.2–4.5 µm in CB, MLZ (x = 11.9 x 4.0 µm, n = 17). Paraphyses filiform with subclavate tips, septate, mostly thin-walled and simple, at the extreme margin occasionally with conical, glassy thickenings as in hairs, basally 1.5–2 µm in diam., apically swollen up to 3.0 µm, when bearing glassy apices up to 5.0 µm.

Holotype: On dead herbaceous stems, Tadjikistan, Pamiro-Alai Mountains, Darvaz range, Haburabat Pass, 3050 m a.s.l., 24.06.1982 A. Raitviir (TAA–64958). – Paratype: on culms of *Cirsium spinosissimum,* Austria, Tirol, Stubaital, 1905 Rehm (F).

This species exhibits characters apparently intermediate between those seen in *Urceolella* Boud. and *Hyalopeziza.* After heating in 10 % KOH, hair structure remains intact. The glassy material is not dissolved and becomes only slightly less refractive. On the other hand, the glassy apices of paraphyses and other characteristics link this species relatively closely to *Urceolella hamulata* (Rehm) Korf & Kohn. However, there is a basic difference in the paraphyses: in this species all paraphyses except those at the transitional zone are thin-walled whereas those in *U. hamulata* have glassy apices all throughout the hymenium.

Hyalopeziza cadaverina Huhtinen & Raitv. sp. nov. – Fig. 2

Apothecia gregaria, superficialia, stipitata, cupulata, extus albida, margine breviter pilosa, disco ad usque 150 µm diametro, albida. Stipes circa 80–110 x 20–30 µm. Excipulum ectale ex cellulis prismaticis hyalinis crassiter tunicatis 10–12 x 3–4 µm compositur. Pili cylindraceo-angustati, 0–1-septati, hyalini, 20–30 x 2–3 µm, basaliter tenuiter tunicati, apicibus solidis, vitreis. Asci cylindraceo-clavati, uncinati, poro inamyloideo, 27–36 x 4.2–5.8 µm. Sporae ellipsoideo-subfusoideae, hyaline, aseptatae, indistincte multiguttulatae, 4.0–5.8 x 1.6–2.2 µm. Paraphyses filiformes, rariter ramosi in partes inferiores, ascos non superantes, 1.0–1.5 µm diametro.

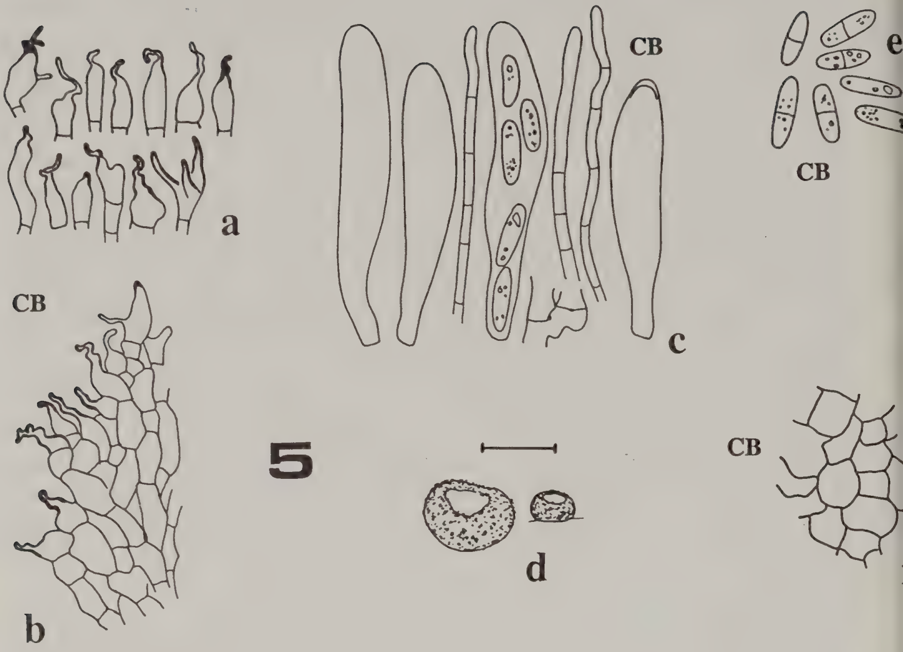
Holotypus: ad lignum decorticatum, Japan, Hokkaido, Ishikari Prov., Toyohiracho, Jozankei, 18.05.1958 Kamei & Yokoyama & Korf (CUP–JA 695).

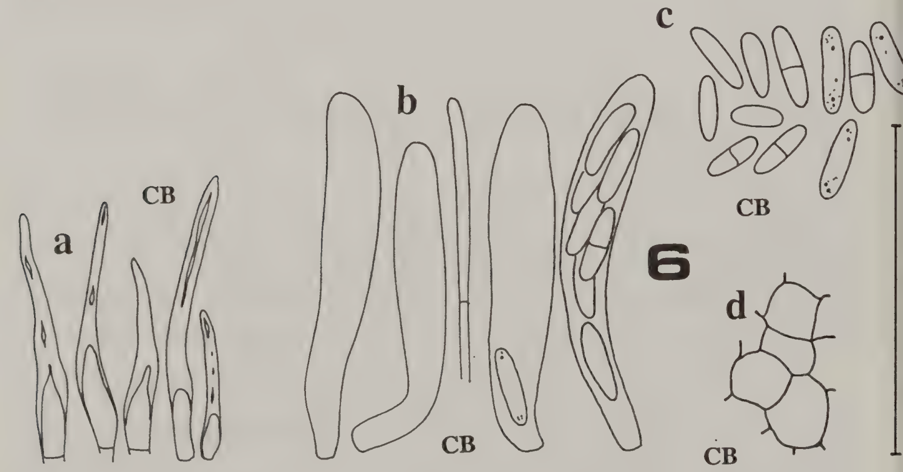
Apothecia gregarious, superficial, stalked. Disc up to 150 µm in diam., whitish. Receptacle cupulate, concolorous with the hymenium, at the margin shortly hairy; stipe ca. 80–110 x 20–30 µm. Ectal excipulum composed of hyaline, thin-walled, prismatic cells, measuring 10–12 x 3–4 µm, remaining hyaline in CB, CR, becoming moderately wine-red in MLZ; close to margin cells narrower; on stipe 14–16 x 2.5–3.0 µm, somewhat firm-walled. Hairs cylindrical-tapering, 0–1-septate, hyaline, 20–30 x 2–3 µm, basally thin-walled, apically with solid, glassy walls; glassy material not losing refractiveness in KOH, remaining hyaline in CB, CR, clearly wine-red in MLZ; occasionally the septum or restricted areas on lower walls with a clear dextrinoid reaction too. Asci cylindric-clavate, arising from croziers, apical pore not stained blue in MLZ, not even after KOH-pretreatment, measuring 27–36 x 4.2–5.8 µm in CB (x = 31.6 x 4.9 µm, n = 10). Ascospores elliptic-subfusoid, hyaline, aseptate, indistinctly multiguttulate in CB, MLZ, measuring 4.0–5.8 x 1.6–2.2 µm in CB, MLZ (x = 4.9 x 1.9 µm, n = 15). Paraphyses filiform, rarely branching in lower parts, not exceeding the asci, 1.0–1.5 µm in diam.

Holotype: on decorticated wood, Japan, Hokkaido, Ishikari Prov., Toyohiracho, Jozankei, 18.05.1958 Kamei & Yokoyama & Korf (CUP–JA 695).

The hairs with dextrinoid, glassy apices bear some resemblance to those of the genus *Protounguicularia* Raitv. & Galán, recently placed into the synonymy of *Olla* Velen. by Baral (1993). They are, however, mostly tapering and aseptate in their part which exceeds the asci. Also the clearly stipitate habit of apothecia is not typical of *Protounguicularia*. Hence, the species is placed in *Hyalopeziza*.

The diagnosis of *Protounguicularia vandae* (Velen.) Svrček is a fairly good match with the present taxon. Marked differences are, however, evident in the sessile habit, MLZ+ asci and broader spores of *P. vandae* (Svrček 1991). It should be noted, however, that the transfer of *Chrysothallus vandae* Velen. to *Protounguicularia* is surprising because Galán et al. (1994) have found that Velenovsky's lectotype specimen (PR–149994) is identical to *Graddonidiscus coruscatus* (Graddon) Raitv. & Galán and offers an earlier name for this species.





Figs. 5–6. *Hyalopeziza peleana* and *Hyalopeziza raripila,* scale 50 µm, for apothecia 100 µm. – Fig. 5. Holotype of *H. peleana* a) marginal hairs b) detail from the flanks c) asci and paraphyses d) dry apothecia e) ascospores f) ectal excipulum from medial flank area. – Fig 6. Holotype of *H. arctica* a) marginal hairs b) asci and paraphysis c) ascospores d) ectal excipulum from medial flank area.

Urceolella peleana Huhtinen & Raitv. sp. nov. – Fig. 5

Apothecia sessilia, ad usque 0.25 mm in diametro, cupulata, extus dense albopilosa, disco pallide luteobrunneo. Excipulum ectale ex cellulis angularis hyalinis tenuiter tunicatis compositur. Pili conici, simplices vel ramosi, 7–18 x 2.5–6.0 µm, basi tenuiter tunicatis, apicibus vitreis, abrupte acutis, curvatis vel contortis.. Asci clavati, octospori, uncinati, poro iodo coerulescentia, 36–46 x 5.8–8.2 µm. Sporae cylindraceo-ellipsoideae, hyalinae, aseptatae vel uniseptatae, minute multiguttulatae, 8.0–10.6 x 2.4–4.0 µm. Paraphyses filiformes, 1.2–2 µm in diametro, dense septatis.

Holotypus: ad corticem dejectum Acaciae koae, U.S.A., Hawaii, Oahu, Honolulu, apud vallim superiorem Manda, plantatio sylvaticum, 600 m alt., 20.09.1939, Bessey 429 (BPI).

Apothecia scattered, superficial, sessile. Disc up to 250 µm in diam., somewhat waxy, light yellowish brown, with an olivaceous tinge (substrate is shining through) when dry. Receptacle cupulate, whitish due to a dense cover of hyaline hairs. Ectal excipulum composed of hyaline, thin-walled, angular cells, measuring 6–9 x 4–7 µm (Q = 1.5), remaining hyaline in CB, MLZ. Hairs conical, often somewhat abruptly tapering to a narrow apical part, simple to branched, apex typically curved or contorted, aseptate, hyaline, measuring 7–18 x 2.5–6.0 µm, with thin basal walls and glassy apices, mostly showing a narrow lumen throughout, more rarely solid; glassy material losing refractiveness in 10% KOH. Asci clavate, eight-spored, arising from croziers, these CR+, apical pore clearly blue in MLZ, measuring 36–46 x 5.8–8.2 µm in CB (x = 41 x 6.9 µm, n = 10). Ascospores cylindrical-ellipsoid, hyaline, aseptate to one-septate, minutely multiguttulate in CB and CR, measuring 8.0–10.6 x 2.4–4.0 µm in CB (x = 8.8 x 2.8 µm, n = 10); spore wall thin, in over?mature spores 0.3–0.4 µm thick (in CB). Paraphyses filiform, 1.2–2.0 µm in diam., thin-walled, densely septate, septal intervals 5–8 µm below, terminal cells often somewhat longer, 9–21 µm long.

Holotype: on fallen bark of *Acacia koa,* U.S.A., Hawaii, Oahu, Honolulu, upper Manda Valley, Hawaiian Sugar Plantation Association forest plantation, 600 m a.s.l., 20.09.1939 Bessey 429 (BPI).

This new species may at first sight be determined as a species of *Mollisina,* due to the minute hairs with solidifications. These hairs are not, however, beset with numerous finger-like, solid projections, as is the case in *Mollisina.* The flanks in *U. peleana* are covered with normal hairs, whereas in *Mollisina* the excipular cells often show short, solid projections arising straight from the cell walls.

The closest look-alike for *U. peleana* is *Urceolella pani* (Velen.) Huhtinen. The two taxa are alike except for the more irregular, dwarfish hairs and larger spores of *U. peleana.* As is the case in *U. pani,* the reaction of hair solidifications in KOH also place the present species in the genus *Urceolella.*

Hyalopeziza raripila (Höhn.) Huhtinen – Fig. 6

= *Hyalopeziza arctica* Raitv., Fol. Crypt. Est. **23**: 5. 1985. – Holotype: on culm of *Delphinium,* Russia, Krasnoyarsk Region, Taimyr peninsula, Talnakh, 12.08.1967 Põldmaa (TAA 32193, examined).

Modern diagnoses of this species can be found in Raschle (1977) and Huhtinen (1987e). A comparison of the type collection of *Hyalopeziza arctica* Raitv. (Raitviir 1985) showed that this is a synonym of *H. raripila.* The two collections are very similar in all characters. A check of ascal bases indicated that also *H. arctica* has croziers. The same is true of material from Tübingen, Germany (collection Baral 4092b).

The type collection of *H. arctica* widens the range of spore width observed in *H. raripila.* Approximately 25 % of the mature spores are one-septate and exceed 3.0 µm in width. These wider spores and the more narrow spores prevailing in southern material are often seen within a single ascus. The presence of up to 3.7 µm wide spores being the only notable difference between the two taxa, they should not be maintained under separate epithets.

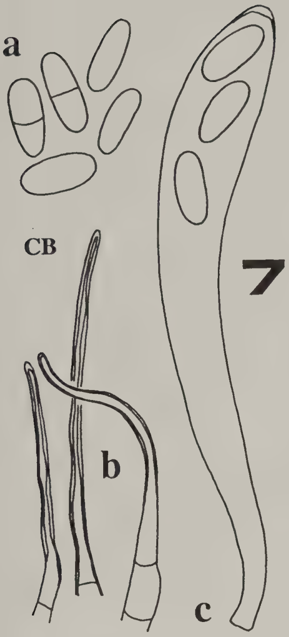
The name '*raripila*' does not serve the taxon well. The three collections cited here all have a dense hair covering on the flanks. In addition to Austria, Finland and Russia, *H. raripila* is reported from France, Germany and Luxembourg (Krieglsteiner 1993).

Hyalopeziza latispora Raitv. – Figs. 7–12

Hyalopeziza latispora Raitv., Fol. Crypt. Est. **12**: 4. 1981. – Holotype: on stems of *Angelica* sp., Kyrghystan, Tien-shan, Teskei Alatoo Range, Djon-Kyzyl-su, 06.06.1971, Kullman (TAA 65207, examined).

= *Hyalopeziza schachdarica* Raitv., Fol. Crypt. Est. **12**: 4. 1981. – Holotype: on herbaceous stems, Tadjikistan, Pamir, Ishkashim Range, in the valley of rivers Shakh-dara and Tavdem-dara, 03.06.1978 Raitviir (TAA 64681, examined).

Figs. 7–9. *Hyalopeziza latispora,* scale 50 µm. – Fig. 7. Holotype of *Hyalopeziza schachdarica* a) ascospores b) marginal hairs c) ascus. – Fig. 8. Holotype of *H. latispora* a) marginal hairs b) ascospores c) ectal excipulum from medial flank area d) asci. – Fig. 9. Paratype of *Hyalopeziza archangelica* a) asci b) ascospores c) ectal excipulum from medial flank area d) marginal hairs.


a
CB
b
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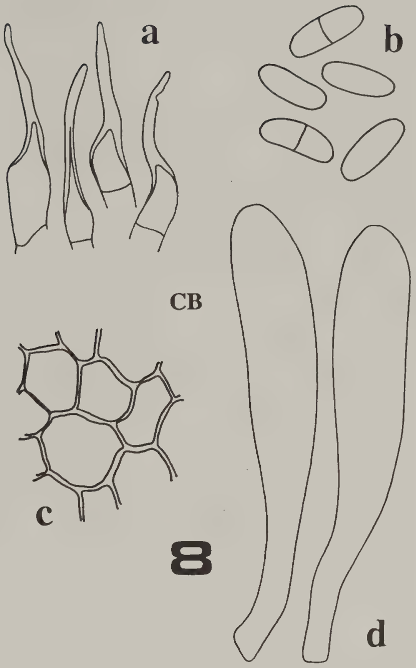
a
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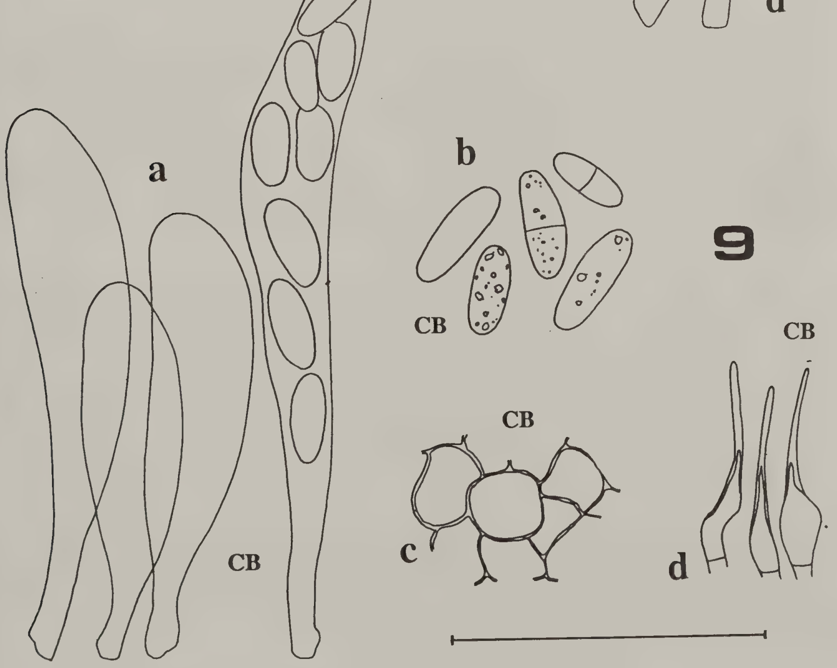
a
CB
b
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9
CB
CB
c
d

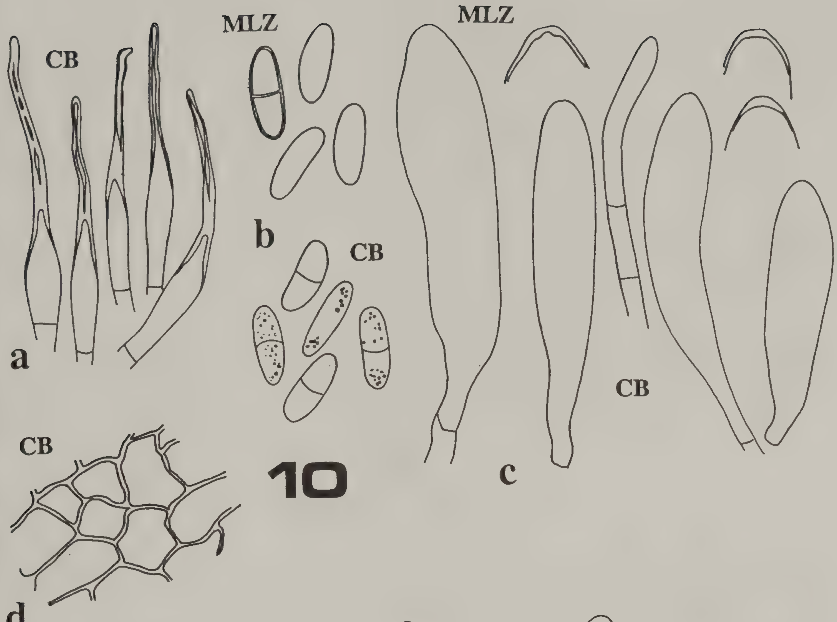
= *Hyalopeziza archangelica* Olsen & Sivertsen, Mycotaxon **47**: 180. 1993. – Holotype: on stems of *Angelica archangelica,* Norway, Nordland, Rana, Fisktjonna, 26.05.1990, Olsen & Sivertsen (BG, not examined).

Apothecia scattered to gregarious, superficial, sessile. Disc 0.2–0.6 mm in diam., whitish to pale yellowish. Receptacle cupulate to saucer-shaped, concolorous with the disc, sparsely covered by short, hyaline hairs. Ectal excipulum composed of hyaline, angular, more or less isodiametric cells measuring 9–15 x 8–15 µm (Q = 1.1), remaining hyaline in CB, CR and MLZ. Hairs conical to lageniform, straight to curved, rarely somewhat flexuous, measuring 26–52 x 4–7 µm, thin-walled at extreme basis, with or without a narrow lumen in apical part, aseptate, once seen to be one-septate, smooth, in one collection rarely with attached, persistent, brown granulation; walls not losing refractiveness in KOH, remaining hyaline in CB, MLZ. Asci cylindrical-clavate to broadly clavate, arising from croziers, eight-spored, MLZ-, measuring (40–)55–110(–130) x 8–12(–16) µm in CB (x = 78 x 11.1 µm, n =30, from 6 populations). Ascospores ellipsoid to elongate, slightly inequilateral, hyaline, aseptate to one-septate, aguttulate to minutely guttulate in CB, measuring 10–14(–18) x 3.5–5.0(–6.0) µm in CB (x = 12.4 x 4.4 µm, n = 50, from 6 populations); septum MLZ-. Paraphyses cylindrical, with equal or slightly widened apex, 1.8–2.0 µm in diam. below, terminal cells 16–38 x 2–3 µm.

Other collections: on stems of *Cirsium spinosissimum,* France, Lanslebourg, Val d'Isere, Prariond, 31.08.1992 Huhtinen 92–99a (TUR 105053). – On *Angelica,* Greenland, Godhavn, Kuanit, 05.08.1970 Petersen 70.120 (CUP 59476, paratype of *Hyalopeziza archangelica).* – On *Angelica archangelica,* Norway, Finnmark, near Talvik, Vassbotn, 16.08.1978 Sivertsen & Dissing & Korf (CUP 59128). – on stem of *Veratrum,* Huizky Dom?, 11.06.1965 Gremmen 2280 (CUP–G 1191).

The present taxon is noteworthy for the exceptional size range exhibited by asci and spores. Notable variation is seen not only between populations, but even between different apothecia of a single population. Mature asci often show 30–50 % variability in length within a population. Elongated asci with a Q-value of 7.6 (in CB) can be coupled with broadly clavate asci (Q = 3.5) in another apothecium from the same population. The mean spore measurement between the extreme populations are: 11.0 x 4.1 µm and 14.2 x 5.3 µm.

Figs. 10–11. *Hyalopeziza latispora,* scale 50 µm. – Fig. 10. Collection CUP 59128 a) marginal hairs b) ascospores c) asci and paraphysis d) ectal excipulum from medial flank area. – Fig. 11. Collection Huhtinen 92–99a a) marginal hairs b) ascospores c) asci and paraphysis.



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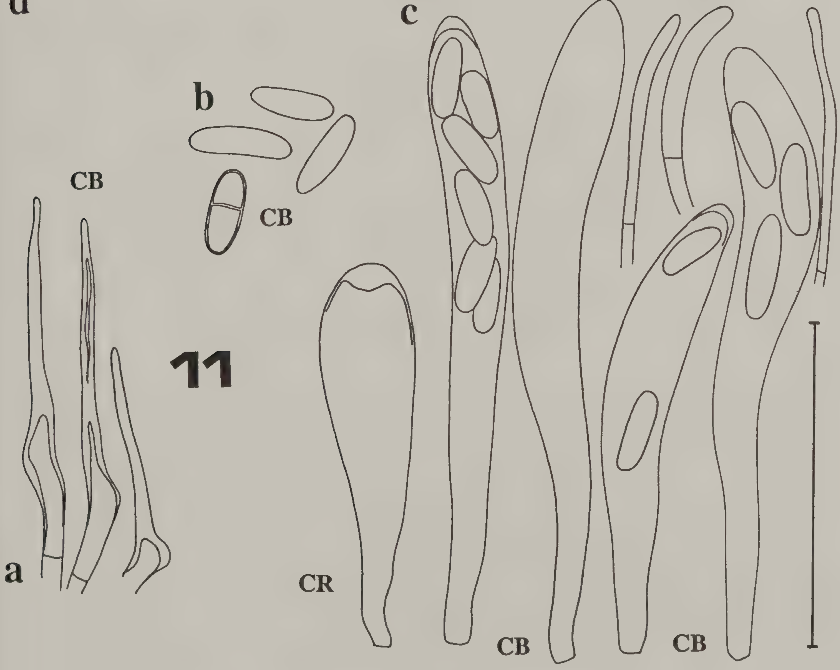

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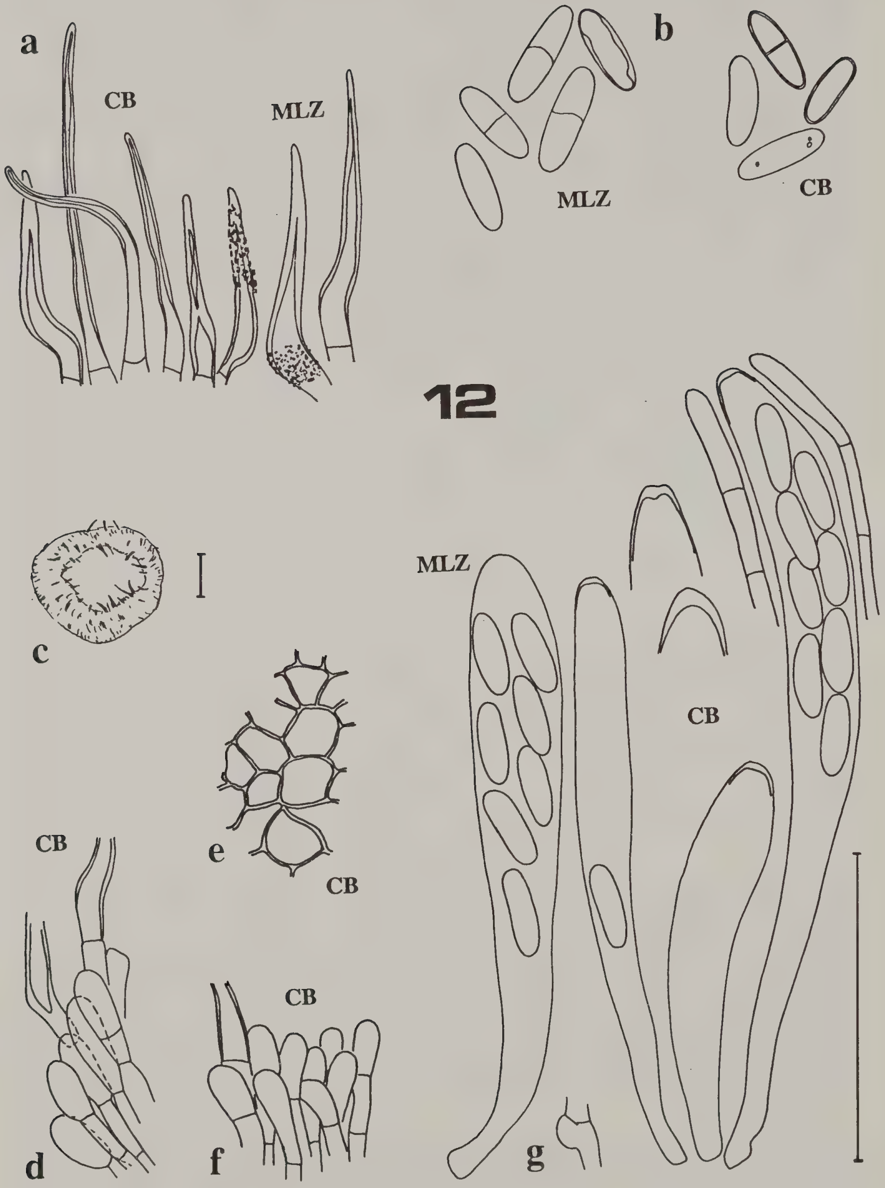

12

The amount of accepted variation may seem great, but there are many linking characters. Interpopulationary variation proves the species to be variable; hence more stress should be laid on croziers, MLZ-ascal reaction, identical hairs, similar excipular structure etc. in evaluating the taxonomy.

Further studies based on more extensive material may, however, confirm the idea of the first author that two altitudinal races exist in this species. In collections from lower altitudes one can never find elongated asci exceeding 100 µm which are typical for collections from higher altitudes. A similar situation is described for two geographical races of *Graddonidiscus hispanicus* (Galán et al., 1994). The typical race of this species from Spain has always shorter asci together with long asci but *G. hispanicus* var. *californicus* has never so long asci as the typical race.

As discussed by Olsen et al. (1993) this taxon was treated earlier by Korf (1980) under a provisionary name "*Chaetonaevia archangelica*". The synonymy of *H. archangelica* with *H. latispora* was confirmed by studying a paratype of that species.

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References

Baral, H.O. 1993: Beiträge zur Taxonomie der Discomyceten 3. – Z. Mykol. **59**: 3–22.

Galán, R., Raitviir, A., Ayala, N. & Ochoa, C. 1994: First contribution to the Leotiales of Baja California and adjacent areas. – Mycol. Res. **98**: 1137–1152.

Huhtinen, S. 1987a: Three new species and the histochemical delimitation of genera in the glassy-haired Hyaloscyphaceae. – Mycotaxon **29**: 267–283.

Huhtinen, S. 1987b: Taxonomic studies in the genera *Protounguicularia, Arachnopeziza* and *Dematioscypha.* – Mycotaxon 30: 9–28.

Huhtinen, S. 1987c: The genus *Protounguicularia* in Europe. – Beiträge zur Kenntnis der Pilze Mitteleuropas 3: 457–463.

Huhtinen, S. 1987d: New Svalbard fungi, pp. 123–151. – In: Laursen,G.A., Ammirati, J.F. & Redhead, S.A. (eds.): Arctic and Alpine Mycology

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Fig 12. *Hyalopeziza latispora,* collection CUP–G–1191, scale 50 µm, for apothecium 200 µm. a) marginal hairs b) ascospores c) dry apothecium d) detail from the flanks e) ectal excipulum from the middle flank area f) detail from the margin g) asci and paraphyses.

2. Plenum Press, New York. 364 pp.

Huhtinen, S. 1987e: Five glassy-haired Hyaloscyphaceae. – Karstenia **27**: 8–14.

Korf, R.P. 1980: Inoperculate discomycetes of the arctic and alpine zones of Finnmark, Lapland, and Greenland. – In: Laursen, G.A. & Ammirati, J.F. (eds.): Arctic and Alpine Mycology. University of Washington Press, Seattle and London. 559 pp.

Korf, R.P. & Kohn, L. 1980: Revisionary studies in the Hyaloscyphaceae 1. On genera with "glassy" hairs. – Mycotaxon **10**: 503–512.

Krieglsteiner, G.J. 1993: Verbreitungsatlas der Grosspilze Deutschlands (West) 2: Schlauchpilze. Verlag Eugen Ulmer, Stuttgart. 596 pp.

Matheis, W. 1977: *Cistella amenticola* sp. nov. nebst Bemerkungen über einige andere *Cistella*-Arten. – Friesia **11**: 85–93.

Olsen, S., Haines, J. & Sivertsen, S. 1993: Three new hyaloscyphaceous fungi from Norway and Greenland. – Mycotaxon 47: 177–182.

Raitviir, A. 1970: Synopsis of the Hyaloscyphaceae. – Scripta Mycol. **1**: 1–115.

Raitviir, A. 1985: Four new species of the Hyaloscyphaceae. – Fol. Crypt. Est. **23**: 5–7.

Raitviir, A. & Galán, R. 1986: A new genus of the Hyaloscyphaceae. – Int. J. mycol. lichenol. **2**: 221–234.

Raitviir, A. & Galán, R.. 1993: Notes on Spanish glassy-haired Hyalosyphaceae. – Sydowia **45**: 34–54.

Raschle, P. 1977: Taxonomische Untersuchungen an Ascomyceten aus der Familie der Hyaloscyphaceae Nannnfeldt. – Sydowia **29:** 170–236.

Svrček, M. 1986: New or less knwon Discomycetes. 14. – Česka Mykol. **40**: 203–217.

Svrček, M. 1987: The European genera of the family Hyaloscyphaceae (Helotiales). – Česka Mykol. **41**: 193–206.

Svrček, M. 1991: New or less known Discomycetes. 21. – Česka Mykol **45**: 134–143

Zhuang, W.-Y. 1988: A monograph of the genus Unguiculariopsis (Leotiaceae, Encoelioideae). – Mycotaxon **32**: 1–83.

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SEPTORIA VULCANI SP. NOV. ON ENDEMIC *RUMEX* IN HAWAI'I

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Abstract

Septoria vulcani sp. nov. is described. The fungus produces leaf spots on *Rumex skottsbergii* and *R. giganteus*, closely related constituents of Hawai'i's endemic flora. The hosts occur as shrubs of forest understory or open lava fields and are distinct from the weedy *Rumex* hosts other *Septoria* spp. have been reported on elsewhere. This appears to be the first report of a *Septoria* on members of the Polygonaceae in Hawai'i.

Rumex skottsbergii Deg. & Deg. and *R. giganteus* Ait. (Polygonaceae), both known by the common name "pawale," are shrubs endemic to the Hawaiian Islands. These species are morphologically variable and of such close affinity to one another that determination of correct specific identities among populations has been a matter of considerable confusion (Wagner *et al.*, 1990; L. Pratt, personal communication). As generally recognized currently, *R. giganteus* is an understory component of mesic to wet forests on the islands of Moloka'i, Maui and Hawai'i, whereas *R. skottsbergii* is found on the island of Hawai'i where it colonizes dry, open lava fields.

A leaf spotting disease occurs on these *Rumex* species, usually producing few to several scattered lesions visible on both surfaces. However, the disease has been found to be particularly severe on a population of *R. skottsbergii* colonizing a recent cinder deposit in the "Devastation Area" of Hawai'i Volcanoes National Park. Although conspicuous infection has been observed at this site in the spring, seasonality is probably less a factor in disease occurrence than are local moisture conditions. On heavily infected leaves, spots coalesce into necrotic blotches while the remaining leaf tissue becomes chlorotic, followed by defoliation. Pycnidia of a previously undescribed species of *Septoria* are scattered prominently within the necrotic tissue, exuding cirrhi under humid conditions.

Septoria vulcani D. Gardner, sp. nov. Figs. 1-3

Maculae mortuae 2–5 mm diametro, amphigenae, coalescentes ut maculas mortuas forment. Conidiomata pycnidialia per texturam mortuam dispersa, sphaerica usque ad ampuliformia, 50–8 µm diametro, valde ostiolata. Conidia filiformia, recta aut curvata, (20)23–28(40) × 2–3 µm, 1–4 septate.

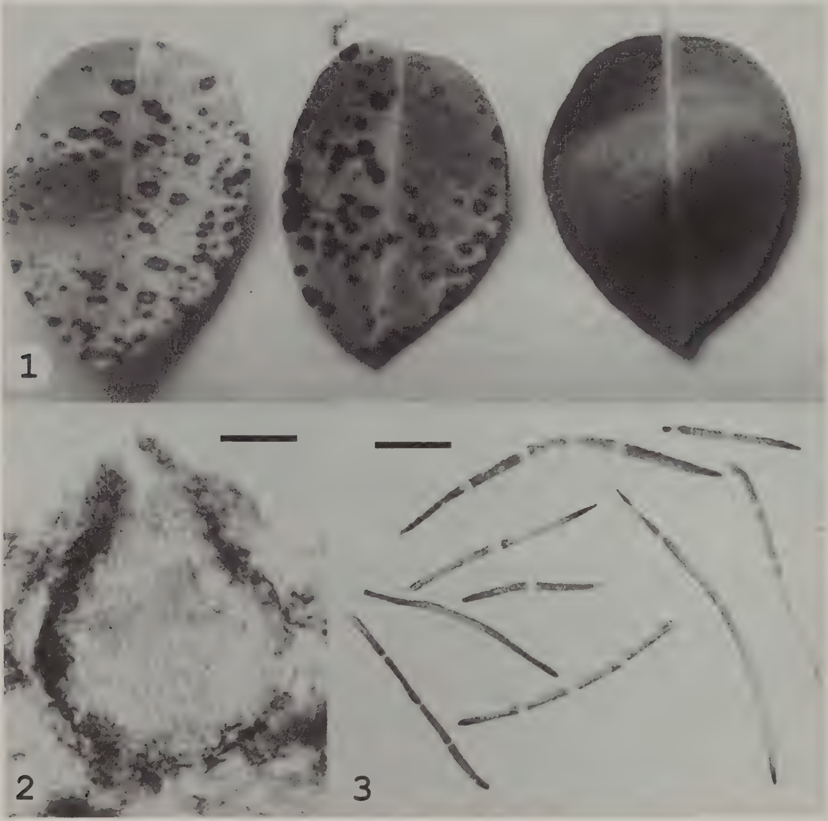
In foliis vivis *Rumicis skottsbergii*.

Holotypus BISH 644952; Isotypus BPI 737877

Etymologia: Referens consortionem hospitis cum substrato recento volcanico.

Necrotic spots 2–5 mm diameter, amphigenous, coalescing to form necrotic blotches, pycnidial conidiomata scattered throughout necrotic tissue, spherical to flask-shaped, 50–80 µm diameter, prominently ostiolate. Conidia filiform, straight or curved, (20)23–28(40) × 2–3 µm, 1–4 septate.

Etymology: Refers to the association of the host with recent volcanic substrate.



Figures 1–3. *Septoria vulcani.* 1. Leaf spots on *Rumex skottsbergii* (healthy leaf at right). 2. Pycnidial conidioma; scale line = 21 µm. 3. Conidia; scale line = 9 µm.

Delimitation of species within genera of many cosmopolitan plant pathogenic coelomycetes, including *Septoria*, has been based widely on the assumption of host specificity, together with the morphological characteristics of fruiting structures and conidia. Of the numerous species of *Septoria* described, eight have been reported on hosts of the genus *Rumex* (Table 1).

Table 1. Species of *Septoria* reported on hosts of *Rumex* spp.

Septoria spp.	*Rumex* host	Habitat	Conidiomata diam. (µm)	Conidia (µm)
S. acetosae Oud.[a]	*R. acetosa* L.	Netherlands	1,000	40–50 × 4; 1–3 septate
S. glacialis Ferr.[b]	*R. scutatus* L.	Europe; Orient[c]	120–140	35–40 × 2–2.3; 2–septate
S. pleosporoides Sacc.[d, e]	*R. acetosa* L., *R. acetosella* L., *Rumex* sp.	Texas; Germany	500	38–50 × 1–1.5 (septation not given)
S. rumicis Ell.[f, g]	*Rumex* sp.	Minnesota	not given	15-25 × 1.5–2 (septation not given)
S. rumicis Trail[h]	*R. acetosa* L.	Midwestern US; Norway	90–100	24–32 × 2.5; 1–2 septate
S. rumicis-papillaris Cab.[i]	*R. papillaris* Boiss. & Reut.[j]	Spain	130–240	33–53 × 3–4 (septation not given)
S. rumicicola Allesch.[k]	---	---	---	---
S. rumicum Sacc. & Paol.[l]	*R. acetosa* L.	? Siberia	100–125	50–68 × 3 (septation not given)

[a] Saccardo, 1895
[b] Saccardo, 1906
[c] Kew Index, p. 766
[d] Saccardo, 1884; Farr *et al.,* 1989
[e] as *Rhabdospora pleosporoides* Sacc.
[f] Saccardo, 1895
[g] homonym of *S. rumicis* Trail
[h] Saccardo, 1892; Farr *et al*., 1989
[i] Caballero, 1928
[j] synonym of *R. acetosa* L. (Kew Index, p. 766)
[k] Saccardo (1902) referred this species to *S. rumicis* Ell., which in turn was referred to *S. rumicis* Trail.
[l] Saccardo, 1892

Aside from the morphological distinctions of *S. vulcani* from the *Septoria* spp. noted in Table 1, other *Rumex* hosts of *Septoria*, such as *R. acetosa*, are principally weedy herbaceous species. While most species of the Polygonaceae in Hawai'i are weedy introductions, no *Septoria*-related disease of *Rumex*, or any other member of the Polygonaceae, is known to have been reported previously from Hawai'i (Raabe *et al.*, 1981). *Septoria vulcani* occurs on non-weedy shrubs valued as constituents of Hawai'i's endemic flora, the world's most geographically isolated. Origins of microorganisms, including fungi, are often more difficult to determine than are those of higher forms of life such as vascular plants. However, given the assumption of host specificity, occurrence on an endemic host suggests that the fungus itself is endemic, supporting its status as a new species. This consideration is important to resource managers of natural systems, such as those of national parks, whose purpose it is to preserve native organisms while controlling non-native invaders.

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Literature Cited

Caballero, A. 1928. Adiciones la microflora Española. Boletin de la Real Sociedad Española de Historia Natural 28(1):421-430.
Farr, D. F., G. F. Bills, G. P. Chamuris, and A. Y. Rossman. 1989. Fungi on plants and plant products in the United States. The American Phytopathological Society, St. Paul, Minnesota.
Kew Index. 1895. Clarendon Press, Oxford.
Raabe, R. D., Conners, I. L., and Martinez, A. P. 1981. Checklist of Plant Diseases in Hawai'i. Univ. Hawai'i Press, Honolulu, Hawai'i.
Saccardo, P. A. 1884. Sylloge fungorum 3:588.
Saccardo, P. A. 1892. Sylloge fungorum 10:380.
Saccardo, P. A. 1895. Sylloge fungorum 11:545.
Saccardo, P. A. 1902. Sylloge fungorum 16:971.
Saccardo, P. A. 1906. Sylloge fungorum 18:390.
Wagner, W. L., D. R. Herbst, and S. H. Sohmer. 1990. Manual of the flowering plants of Hawai'i. Vols. 1 & 2. University of Hawai'i Press and Bishop Museum Press, Honolulu.

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NOTES ON FUNGI ON HAWAIIAN TREE FERNS

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SUMMARY

Twenty-six fungi are reported from species of the genus *Cibotium* and other Hawaiian tree ferns. All are basidiomycetes except *Ascocoryne sarcoides*, *Hobsonia gigantea*, *Lachnella gleicheniae*, and *Lycogala epidendrum*. Senescent petioles of the basal leaves are the main substrate. Five species, *Athelia cibotii*, *Botryobasidium ampullatum*, *Bourdotia kipukaensis*, *Hymenochaete tomentelloidea*, and *Vararia microhyphidia* are new.

The large endemic tree ferns of Hawai‘i are in the genus *Cibotium* of the Cyathaceae. According to Wagner (1990) the genus is a small one and the number of species in Hawai‘i is uncertain. It may be as low as three and as high as seven. For keys to the Hawaiian species of *Cibotium* see Becker (1984) and Wagner (1990). All of the fungi on *Cibotium* in this paper were collected by the authors on the island of Hawai‘i where three species are substrates. In some areas one species may be predominant but in other areas all three species may be present. The three species on Hawai‘i that were substrates for fungi reported here are as follows:

Cibotium glaucum (Sm.) Hook. & Arn. Hawaiian name- hāpu‘u pulu. This is the most abundant species on the island of Hawai‘i and also occurs on Kaua‘i, O‘ahu, Moloka‘i, Lāna‘i, and Maui.

Cibotium chamissoi Kaulf. Hawaiian name- hāpu‘u i‘i. This is the second most abundant and most robust of the three species and also occurs on Kaua‘i, O‘ahu, Moloka‘i, Lāna‘i, and Maui.

Cibotium hawaiense Nakai & Ogura. Hawaiian name- meu. This is the least abundant of the three species and is restricted to the island of Hawai‘i.

Most of our collections on Hawai‘i were made in the following locations:

1. The vicinity of the Thurston Lava Tube, Hawai‘i Volcanoes National Park (HVNP), Ka‘ū District. The tree ferns here are mostly *C. glaucum* with a small percentage of the other two species.
2. Kīpukas (islands of forest in lava fields) at mile 10.5, 18, and 21 on the Saddle Rd.(Highway 200), North Hilo and South Hilo Districts. All three species of *Cibotium* occur in these kīpukas with *C. glaucum* being the most common.
3. Kalopa State Park, off Highway 19, Hamakua District. Most of the collections at this location were on *C. chamissoi*.
4. Honokaia Boy Scout Camp, Highway 19, Hamakua District. Most of the collections at this location were on *C. chamissoi*.

5. Mixed hardwood stands north of Stainback Highway, South Hilo District. Most of the collections at this location were on *C. chamissoi*.

For other localities the complete collection data is given in the text. A smaller endemic tree fern, *Sadleria cyatheoides* Kaulf., is also present throughout the Hawaiian Islands. No collections of fungi were made from this plant. A large introduced tree fern, *Angiopteris evecta* (G. Forst.) Hoffm. is established in some localities on O'ahu and Moloka'i. A few collections were made from this host along the Manoa Falls Trail, Honolulu District, O'ahu.

The usual substrates for fungi on these plants were the persistent senescent petioles on standing live plants or fallen petioles at the base of living plants. All of the fungi reported in this paper appeared to be saprophytes confined to dead tissue. One additional corticioid basidiomycete, *Athelia arachnoideum* (Berk.) Jülich, has been reported on *Cibotium* in Hawai'i (Burt, 1923; Raabe et al., 1981; Farr, et al., 1989). We have not seen specimens to authenticate this record. A number of *Mycena* and *Marasmiellus* species also colonize the senescent petioles of Hawaiian tree ferns and a large *Rhodocollybia* species can be found on fallen trunks. These species will be described in a future paper. Capitalized color names are from Ridgway (1912).

Key to fungi on *Cibotium*

1. Vegetative stage a plasmodium; fruiting body an aethalium . . . . **Lycogala epidendrum**
1. Vegetative stage mycelial; fruiting body otherwise 2

2. Fruiting body a gelatinous sporodochium with helicoid conidia . . . . **Hobsonia gigaspora**
2. Fruiting body an ascocarp or basidiocarp 3

3. Fruiting body an apothecium with asci and ascospores 4
3. Fruiting body a basidiocarp with basidia and basidiospores 5

4. Apothecia bright orange-yellow . . . . **Lachnella gleicheniae**
4. Apothecia reddish-purple . . . . **Ascocoryne sarcoides**

5. Basidiocarp with hymenium enclosed at maturity . . . . . . **Lycoperdon perlatum**
5. Basidiocarp with hymenium exposed at maturity 6

6. Hymenophore of united tubes, polyporoid . . . . **Schizopora flavipora**
6. Hymenophore smooth or hydnaceous 7

7. Basidia vertically or transversely septate 8
7. Basidia nonseptate 10

8. Basidia transversely septate, often helicoid . . . . **Helicogloea lagerheimii**
8. Basidia vertically septate 9

9. Hymenial surface with sterile fascicles of hyphae; basidiospores allantoid, smooth . . . . **Heterochaete verruculosa**

9. Hymenial surface smooth; basidiospores globose, echinulate . . . . ***Bourdotia kipukaensis***

10. Tissue brown; permanently blackening in KOH; hymenium with setae . . . . ***Hymenochaete tomentelloidea***
10. Tissue white to buff, not blackening in KOH; setae not present 11

11. Dextrinoid dendrohyphidia or dichohyphidia present 12
11. Dextrinoid hyphidia not present 14

12. Dextrinoidid dendrohyphidia present; basidiospores globose . . . . ***Scytinostroma hemidichophyticum***
12. Dextrinoid dichohyphidia present; basidiospores not globose 13

13. Dichohyphidia densely branched, minute; basidiospores ellipsoid to navicular . . . . ***Vararia microhyphidia***
13. Dichohyphidia sparsely branched, not minute; basidiospores not observed . . . . ***Vararia sp.***

14. Hymenial surface appearing finely hydnaceous due to crowded minute sterile fascicles; basidiospores globose . . . . ***Epithele hydnoides***
14. Hymenial surface smooth to finely tuberculate or grandinioid; sterile fascicles not present 15

15. Hymenial surface finely tuberculate to grandinioid or hydnaceous 16
15. Hymenial surface smooth 18

16. Hymenium with stellate crystal clusters and capitate cystidioles with halo . . . . ***Resinicium bicolor***
16. Hymenium with incrusted cystidia not as above 17

17. Hymenium with large projecting septate cystidia incrusted except for expanded apex; basidiospores cylindric . . . . ***Hyphoderma nudicephalum***

17. Hymenium with lagenidiform cystidia with incrusted apex and non-incrusted moniliform cystidia; basidiospores subglobose . . . . . . ***Hyphodontia alutaria***

18. Hymenium with large projecting and conspicuous cystidia 19
18. Hymenium lacking sterile elements or with inconspicuous nonprojecting cystidioles 20

19. Cystidia thick-walled, conical, with a sheath of fine hyphae; basidiospores lunate, smooth . . . . ***Tubulicium dussii***
19. Cystidia thin-walled, fusoid, tapering from a broad base, lacking a hyphal sheath; basidiospores broadly ellipsoid, finely verrucose . ***Hypochnicium punctulatum***

20. Hymenium with inconspicuous nonprojecting cystidioles 21
20. Hymenium lacking sterile elements 22

21. Cystidioles broadly fusoid; hyphae simple-septate . . . . ***Athelia pyriformis***
21. Cystidioles narrowly fusoid or capitate; hyphae with clamps . . . . ***Coronicium thymicola***

22. Basidiospores finely echinulate or verrucose 23
22. Basidiospores smooth 24

23. Hyphae agglutinated and indistinct; basidia pleural . . ***Phlebiella tulasnelloidea***
23. Hyphae distinct, loosely interwoven, often ampullate; basidia not pleural . . . . ***Trechispora farinacea***

24. Subiculum virtually absent; basidia borne at apices of erect candelabra of broad, closely septate and swollen hyphae . . . . ***Botryobasidium ampullatum***
24. Subiculum arachnoid to well developed; hymenial layer distinct 25

25. Basidiospores ellipsoid . . . . ***Fibulomyces mutabilis***
25. Basidiospores cylindric, slightly curved to distinctly allantoid . ***Athelia cibotii***

ANNOTATED LIST OF SPECIES

ASCOCORYNE SARCOIDES (Jacq.: Fr.) J.W. Groves & D.E. Wilson
Taxon 16:40. 1967.
Apothecia sessile, fleshy, reddish purple when fresh, drying blackish; asci 8-spored; ascospores cylindric, 2-celled at maturity, 12-14 x 3.5-5 μm. Common on fallen trunks of *Cibotium* spp. DEH 1099, on trunk of fallen *C. glaucum*, Pu'u Maka'ala Nat. Area Reserve, Puna Dist., Hawaii. Cash (1938) reports this fungus from Hawai'i on wood of *Aleurites*.

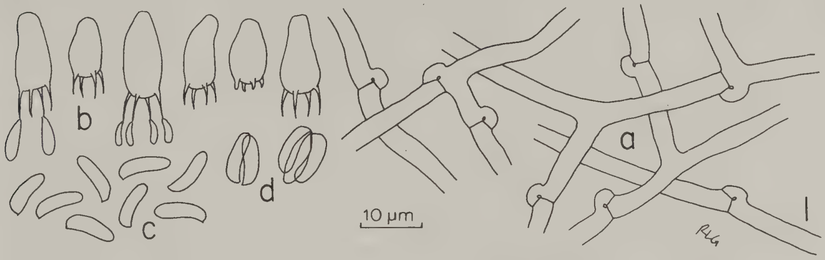
ATHELIA CIBOTII Gilb. & Hemmes. sp nov. Fig. 1
Fructificatio annua, resupinata, textura lenis et facile disjuncta; superficies hymenii laevis, alba vel pallido-bubalina; systema hypharum monomiticum; hyphae fibulatae, 2.5-3.5 μm diam; cystidia nulla; basidia late clavata vel ovoidea, 4-sterigmatica, 10-14 x 6-7 μm; basidiosporae cylindricae vel allantoidae, hyalinae, nonamyloidae, 5-7 x 2-2.5 μm. Holotypus (BPI); RLG 18068, on *Cibotium glaucum*, kīpuka at mile 18, Saddle Rd., South Hilo Dist., Hawai'i.
Etymology: on *Cibotium*.

Basidiocarps resupinate, annual, soft and delicate and easily scraped off, effused to several centimeters but developing in small patches that may or may not become confluent; hymenial surface smooth, off white to Light Buff or Pale Olive Buff; margin abrupt or thinning out; hyphal system monomitic, hyphae thin-walled, with clamps, 2.5-3.5 μm in diam, with frequent branching, often at a septum; cystidia absent; basidia broadly clavate to ovoid and appearing like vesicles at first, staining brightly in phloxine, 4-sterigmate, 10-14 x 6-7 μm; basidiospores cylindric, slightly curved to distinctly allantoid, hyaline, negative in Melzer's reagent, 5-7 x 2-2.5 μm. This is one of the most common species on tree fern petioles and apparently is omnipresent on that substrate. 17009, 17259, 17267, 17268, 17271, 17272, 17274, 17279, 18057, 18067, 18068 (TYPE), 18069, 18070, on *C. glaucum*, kīpuka at Mile 18, Saddle Rd.; 20801, on *C.*

chamissoi, Stainback Highway.

ATHELIA PYRIFORMIS (M.P. Chris.) Jülich Fig. 2
Willdenowia 7:110. 1972.

Basidiocarps annual, resupinate, effused in small patches or these confluent up to 7 cm, soft and fragile and easily scraped from substratum; hymenial surface pelliculose, white to pale pinkish buff, smooth, cracking on drying to reveal a thin, white, arachnoid subiculum, margin thinning out, arachnoid; hyphal system monomitic; subicular hyphae hyaline, thin-walled, simple-septate, uniform in diameter, 2.5-4.5 μm in diam, with frequent branching; cystidia abundant, fusoid, thin-walled, generally not exceeding the basidia, 18-22 x 6-8 μm; basidia broadly clavate, 4-sterigmate, 16-22 x 8-10 μm, simple-septate at the base; basidiospores narrowly ellipsoid to pyriform, hyaline, smooth, thin-walled, negative in Melzer's reagent, 7-9 x 3.5-5 μm. 17019, 17020, 17269, on *C. glaucum*, kīpuka at mile 18, Saddle Rd. In the original description, Jülich (1972) reports bracken fern, *Pteridium aquilinum* (L.) Kuhn., as a substrate for *A. pyriformis* in Europe, but it has not been reported from Hawai'i or on tree ferns.



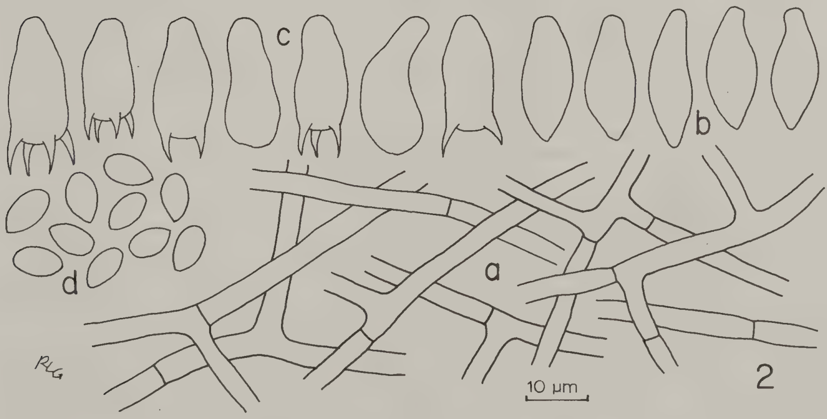


Fig. 1. *Athelia cibotii* (Rlg 18068). a, subicular hyphae; b, basidia; c, basidiospores. Fig. 2. *Athelia pyriformis* (RLG 17020). a, subicular hyphae; b, fusoid cystidioles; c, basidia; d, basidiospores.

BOTRYOBASIDIUM AMPULLATUM Gilb. & Hemmes, sp. nov. Fig. 3
Fructificatio annua, resupinata, tenuis, fragilis; superficies hymenii farinacea, alba vel cremea; systema hypharum monomiticum; hyphae arte septatae, fibulatae et simple-septatae, segmenta inflata, paries cum inaequalis spissescens; hyphae aeriuis in caespes erectus candelabra; basidia brevis et late, subrectangulatae, 4-sterigmatica, 8-10 x 5-6 µm; basidiosporae allantoidae, hyalinae, nonamyloidae, 5-7 x 1-1.5 µm. Holotypus (BPI): RLG 20962, on *Cibotium glaucum*, kīpuka at mile 10.5, Saddle Rd., North Hilo Dist., Hawai'i.

Etymology: from the swollen hyphal segments.

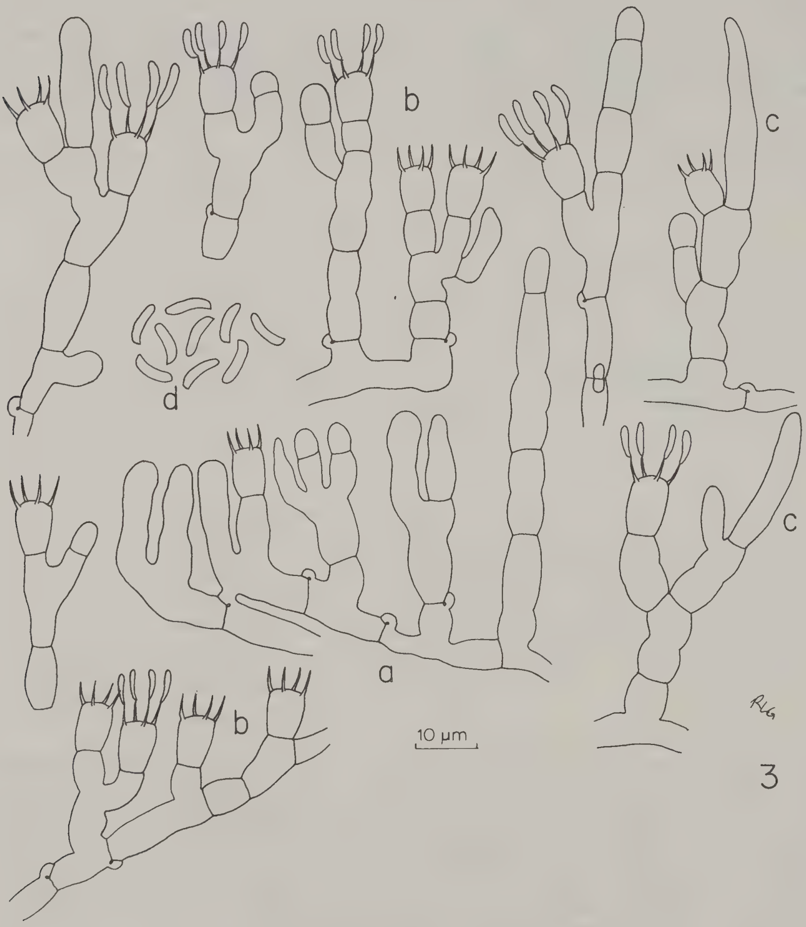
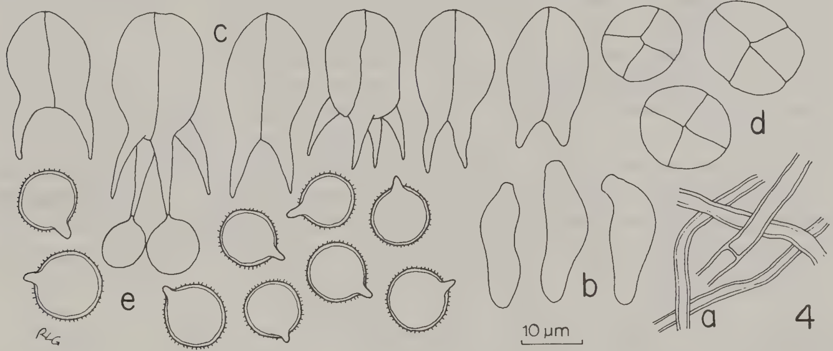


Fig. 3. *Botryobasidium ampullatum* (RLG 20962). a, basal hypha with erect aerial branches; b, basidium-bearing erect aerial branches; c, cystidial elements; d, basidiospores.

Basidiocarps annual, resupinate, effused up to 5 cm, appearing as a white to cream colored farinaceous film; hymenial surface at 30x appearing as a thin layer of crowded tufts or clumps developing directly on the substratum with no apparent subiculum; margin abrupt and apparently fertile to the edge; subicular hyphae not evident; some hyphae on or near the surface of the substratum hyaline, thin- to firm-walled, with clamps, 2-4.5 μm in diam, with frequent branching, often from a clamp; aerial hyphae in erect tufts of branching candelabra, hyaline, thin- to thick-walled, closely septate with some clamps, ampullate, up to 10 μm in diam, wall thickening often irregular; some apical cells elongated, cylindric, cystidioid; basidia borne at apices of candelabral branches, short and broad, almost rectangular in outline, thin-walled, staining brightly in phloxine, 2-4 sterigmate, 8-10 x 5-6 μm; basidiospores narrowly allantoid or crescent shaped, hyaline, smooth, thin-walled, negative in Melzer's reagent, 5-7 x 1-1.5 μm. 17260, on petioles of *C. glaucum*, kīpuka at Mile 18, Saddle Rd.; 20939, 20949, 20962 (TYPE), on *C. glaucum*, 20957 on *C. hawaiense*, kīpuka at mile 10.5, Saddle Rd.; 20805, on *C. chamissoi*, Stainback Highway. This distinctive fungus does not fit readily into any corticioid genera. Because of its loose construction, large, closely septate hyphae, and development of basidia at apices of branches of loose candelabra we believe the best placement among established genera is in *Botryobasidium*.



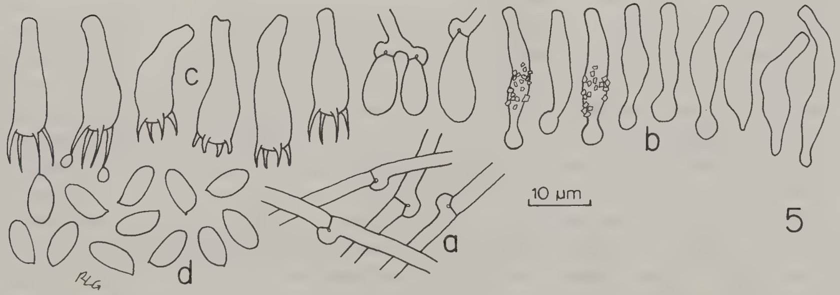


Fig. 4. *Bourdotia kipukaensis* (RLG 17865). a, subicular hyphae; b, gloeocystidia; c, basidia from side view; d, basidia from top view; e, basidiospores. Fig. 5, *Coronicium thymicola* (RLG 18686). a, subicular hyphae; b, capitate and fusoid cystidioles; c, basidia; d, basidiospores.

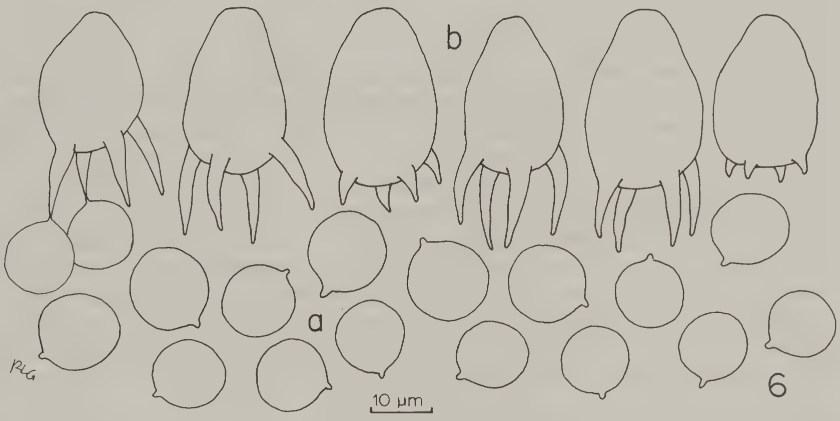
BOURDOTIA KIPUKAENSIS Gilb. & Hemmes, sp. nov. Fig. 4
Fructificatio annua, resupinata, textura farinacea; superficies hymenii cremea vel olivaceo-bubalina; hyphae afibulatae; gloeocystidia aureo-brunnea, 18-24 x 5-7 μm; basidia globosae vel obovatae, septata, 4-sterigmaticum, 15-20 x 12-16 μm; basidiosporae globosae, hyalinae, echinulatae, non-amyloidae, 8-11 μm diam. Holotypus (BPI): RLG 17865, on *C. chamissoi*, Honokaia Boy Scout Camp, Hamakua Dist., Hawai'i.
Etymology: From the kīpukas which are a habitat for this fungus.

Basidiocarps resupinate, annual or perhaps persisting throughout the year, effused up to 10 cm, drying to a thin, discontinuous, farinaceous film, adherent; hymenial surface cream-colored to pale olive buff, margin abrupt to finely fimbriate; tissue gelatinizing and hyphae difficult to discern, short segments firm-walled, simple-septate, 1.5-5.5 μm in diam; gloeocystidia with golden brown contents, thin-walled, 18-24 x 5-7 μm, imbedded or slightly projecting; basidia globose at first, becoming obovate, cruciately septate and 4-celled at maturity, 15-20 x 12-16 μm, developing by repetition at the base and subtended by layers of collapsed old basidial walls, sterigmata 4, up to 3 μm wide at the base and 12 μm long; basidiospores globose, hyaline, with a thickened wall and finely echinulate at maturity, negative in Melzer's reagent, 8-11 μm in diam, with a prominent apiculus. 17439, 17440, 17444, 18997, on *C. chamissoi*, Thurston Lava Tube area, HVNP; 17865 (Type), on *C. chamissoi*, Honokaia Boy Scout Camp. Olive (1958), in a paper on fungi from Tahiti, described *Sebacina aspera* and *S. spinosa*, both with spiny, globose spores. Wells (1959) transferred both species to *Bourdotia*. Comparison of *B. kipukaensis* with the types of these two species described by Olive show them to differ in a number of characters. *B. aspera* has thin, whitish, farinaceous basidiocarps hardly visible to the naked eye, and spores 12-18 μm in diam. *B. spinosa* has thin, ochraceous, farinaceous basidiocarps, and spores 5-6 μm in diam. Gilbertson and Adaskaveg (1993) reported this taxon from Maui on *Eugenia jambos* as *B. aspera*, but pointed out the discrepancy in spore size.

CORONICIUM THYMICOLA (Bourdot & Galzin) Jülich Fig. 5
Persoonia 8:301. 1975.
Basidiocarps annual, resupinate, effused up to 20 cm, not readily separable; hymenial surface uniformly white to cream colored, smooth, cracking into small irregular blocks on drying; margin fertile, abrupt to thinning out; subiculum very thin, barely discernible in sections, essentially represented by a whitish, soft subhymenial zone; hyphal system monomitic; generative hyphae difficult to discern in dried specimens, partially gelatinized in KOH, mostly contorted and distorted, collapsed on drying, 1-3 μm in diam, with obscure clamps; cystidia or cystidioles not projecting or barely projecting beyond the basidia, thin-walled, fusoid or capitate with a spherical apical swelling, the capitate type 15-25 x 3-4.5 μm, the fusoid type 15-30 x 3-6 μm, both types with a basal clamp; basidia broadly clavate, often with a narrowed, stalk-like base, 4-sterigmate, 15-20 x 4.5-6 μm, with a basal clamp; basidiospores narrowly ellipsoid to naviculate, hyaline, smooth, thin-walled, negative in Melzer's reagent, 7-8 x 3-4 μm. 17032, on *C. chamissoi*, Volcano Dump, Highway 11, Puna District, Hawai'i; 18413, on *Angiopteris evecta* (mule foot fern), Manoa Falls Trail, O'ahu; 18686, on *C. chamissoi*, Kalopa State Park; 18941, on *C. chamissoi*, Honokaia Boy Scout Camp; 20806, on *C. chamissoi*, Stainback Highway; 20937, 20944, 20961 on *C. glaucum*, kīpuka at mile 10.5, Saddle

Rd. The spherical apices on the capitate cystidioles are more pronounced than those illustrated for *C. thymicola* by Jülich (1975), but the other microscopic characters and the macroscopic characters fit this species rather well. Not previously reported from Hawai'i.

EPITHELE HYDNOIDES Burt Fig. 6
Ann. Missouri Bot. Gard. 10:188. 1923.
Basidiocarps annual, resupinate, effused in small patches that may become confluent up to 3 cm; hymenial surface Light Buff, appearing finely hydnaceous under 30x lens due to crowded minute sterile fascicles; margin abrupt, or thinning out to a barely visible film; fasicles heavily incrusted, broad and blunt or tapering to the tip, up to 120 μm long and 40 μm wide, hymenium not present on fascicles; hyphae apparently gelatinizing and becoming virtually undiscernible; cystidia absent; basidia ovoid to broadly ellipsoid at maturity, 4-sterigmate, 25-29 x 17-19 μm, sterigmata stout, arcuate, up to 12 μm long and 3 μm wide; basidiospores globose to subglobose, hyaline, smooth, negative in Melzer's reagent, 9-13 μm in diam. 17265, 18059, on *C. glaucum*, kīpuka at mile 18,



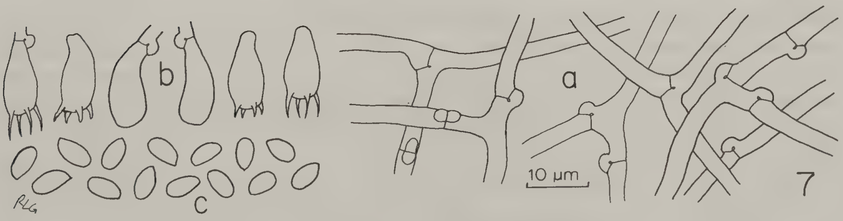


Fig. 6. *Epithele hydnoides* (RLG 18059). a, basidiospores; b, basidia.
Fig. 7. *Fibulomyces mutabilis* (RLG 20963). a, subicular hyphae; b, basidia; c, basidiospores.

Saddle Rd.; 20936, 20938A, 20940, 20941, on *C. glaucum*, kīpuka at mile 10.5, Saddle Rd.; 18666, on *Cibotium* sp., Kalopa State Park. Boquiren (1971) lists several collections of this fungus on *C. chamissoi* in Hawai'i. Burt (1923) also cites a collection from the Hawaiian Islands on *Cibotium* sp.

FIBULOMYCES MUTABILIS (Bres.) Jülich Fig. 7
Willdenowia, Beih. 7:182. 1972.
Basidiocarps annual, resupinate, effused in small scattered patches up to 2.5 cm, pelliculose, fragile and easily separated from substratum; hymenial surface white, smooth, cracking on drying to reveal a thin, arachnoid subiculum; margin thinning out, rhizomorphs absent; hyphal system monomitic; subicular hyphae hyaline, thin-walled, with clamps at all septa, 3-3.5 μm in diam, with frequent branching from clamps or adjacent to septa, loosely arranged and distinct; cystidia or other sterile hymenial elements absent; basidia broadly clavate to subellipsoid, 4-sterigmate, 10-12 x 5-6 μm, with a basal clamp, sterigmata up to 5 μm long; basidiospores ellipsoid, hyaline, thin-walled, smooth, negative in Melzer's reagent, 4.5-5.5 x 2.5-3 μm. 20963, on *C. glaucum*, kīpuka at mile 10.5, Saddle Rd. Not previously reported from Hawai'i.

HELICOGLOEA LAGERHEIMII Pat. Fig. 8
Bull. Soc. Mycol. France 8:121. 1892.
Basidiocarps annual, resupinate, becoming widely effused, gelatinous and colorless, drying to a barely visible, thin, hyaline film that is readily flaked off the substratum; hyphal system monomitic; hyphae thin- to firm-walled, simple-septate, with frequent branching, 33-5 μm in diam; basidial branches with a saccate hypobasidium, this thin-walled, staining brightly in phloxine, oriented away from the growing tip, 12-20 x 6-7 μm; hypobasidium and young epibasidium continuous but separated from the parent hyphae by a septum; epibasidia cylindric, at maturity 50-80 x 5-8 μm, becoming 4-celled, each cell giving rise to a short conical sterigma and a basidiospore; basidiospores broadly ellipsoid or ovoid to subglobose, hyaline, smooth, negative in Melzer's reagent, 8-10.5 x 6.5-8 μm. 17023, on *C. glaucum*, kīpuka at mile 18, Saddle Rd. Baker (1936) reports *H. lagerheimii* from South America, the United States, and Europe. Our collection agrees perfectly with her description. Not previously reported from Hawai'i.

HETEROCHAETE VERRUCULOSA (Möll.) Bodman Fig. 9
Lloydia 15:229. 1952.
Basidiocarps annual, resupinate, when fresh appearing as a thin, grayish-tan film with scattered white, incrusted hyphal fascicles, drying to a thin, translucent film with the incrusted fascicles appearing as small aculei; hyphal fragments with obscure clamps; cystidia broadly fusiform, thin-walled, 25-30 x 7-11 μm; dendrohyphidia with lobate branching at apex, 25-30 x 5-7 μm; basidia globose, becoming vertically septate and 4-celled, 9-11 μm in diam, with 4 sterigmata 10-16 x 2-2.5 μm; basidiospores broadly allantoid, hyaline, smooth, thin-walled, negative in Melzer's reagent, 9-11 x 4-5 μm. 17261, on *C. glaucum*, kīpuka at mile 18, Saddle Rd. Bodman (1952) gives the distribution of *H. verruculosa* as Trinidad, Panama, Columbia, and Brazil but does not mention substrates. Not previously reported from Hawai'i.

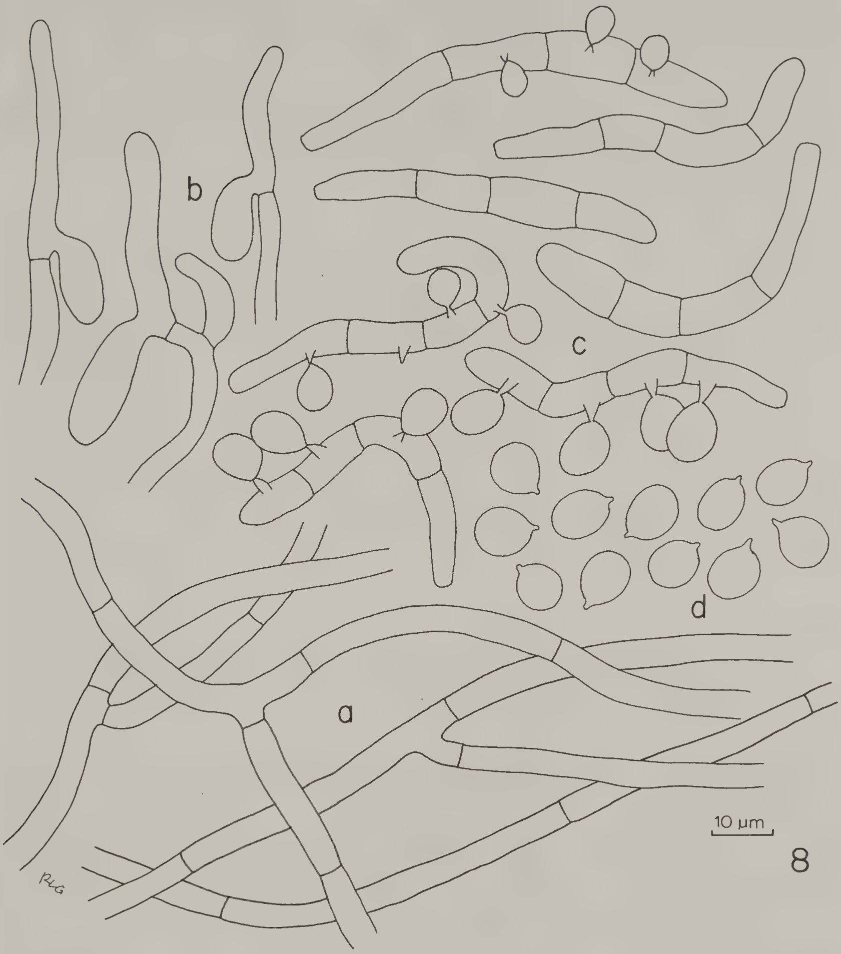


Fig. 8. *Helicogloea lagerheimii* (RLG 17023). a, subicular hyphae; b, young basidia with hypobasidia; c, mature basidia; d, basidiospores.

HOBSONIA GIGASPORA Berk. Fig. 10
in Massee, Ann. Bot. 5:509. 1891.

Fruiting bodies when fresh hemispherical, gelatinous, watery grayish white, soft, up to 8 mm in diam, gregarious in widely spaced groups, under 30x lens appearing full of pellucid sphaerules which are clumps of coiled or helical thick-walled conidia; hyphae simple-septate, 3-8 μm in diam, with occasional branching; conidiophores straight to coiled; conidia multicellular, transversely septate, in the form of tight spirals or helices, cells thick-walled, 8-15 μm in diam, usually with a single large globule. 17025, 17266, 17275, on *C. glaucum*, kīpuka at mile 18, Saddle Rd.; 17283, on *Cibotium* sp., MacKenzie State Park, Puna District, Hawai'i. Linder (1929) recognized two species of *Hobsonia* and differentiated *H. gigaspora* from *H. mirabilis* on the basis of the latter having nongelatinous colonies, which he refers to as sporodochia. He reports the distribution of *H. gigaspora* as Dominica, Guadeloupe, Grenada, and Venezuela. Martin (1937) reported *H. gigaspora* from Panama and Columbia on decayed stems of bamboo. He later (1959) considered other specific names in *Hobsonia* to be synonymous with *H. gigaspora* and reported it from Hawai'i on banana leaves.

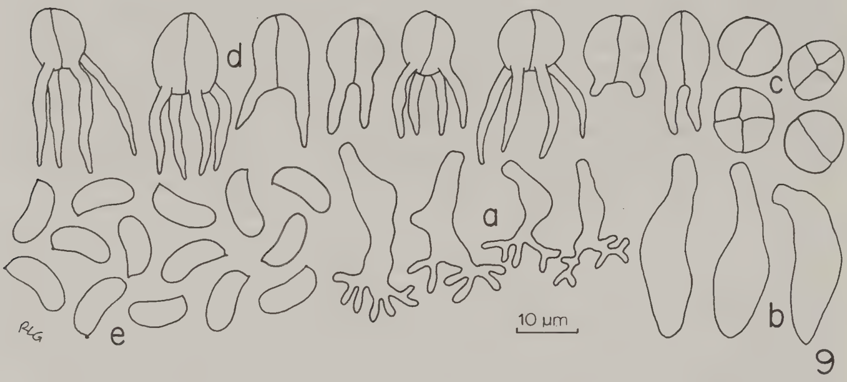


Fig. 9. *Heterochaete verruculosa* (RLG 17261). a, dichohyphidia; b, gloeocystidia; c, basidia from top view; d, basidia from side view; e, basidiospores.

HYMENOCHAETE TOMENTELLOIDEA Gilb. & Hemmes, sp. nov. Fig. 11
Fructificatio annua, resupinata, mollis; superficies hymenii ferruginea, tomentosa; subiculum tenue; systema hypharum monomiticum; hyphae hyalinae vel pallidolutea, firma- vel tenuitunicatae, septatae, afibulatae, 2-2.5 μm diam.; setae abundantae, subulatae, crassitunicatae, 40-65 x 5-7 μm; basidia angustei clavata, 4-sterigmatica, 14-20 x 3-4.5 μm; basidiosporae ellipsoidae vel oblongae, hyalinae, 3-4 x 2-2.5 μm. Holotypus (BPI): RLG 20807, on *C. chamissoi*, Stainback Highway, South Hilo Dist., Hawai'i.
Etymology: resembling *Tomentella*.

Basidiocarps annual, resupinate, Cinnamon-Rufous to Tawny, soft and easily scraped from substrate, setae not apparent under 30x lens, general appearance tomentelloid; with a single setigerous layer and a thin hyphal subiculum, total thickness 60-70 μm; subicular hyphae thin- to firm-walled, hyaline to pale yellowish, with simple septa and occasional branching, uniformly narrow, mostly 2-2.5 μm in diam; setae abundant, subulate, becoming thick-walled, 40-65 x 5-7 μm, many still thin-walled and hyaline to pale yellowish; basidia cylindric to narrowly clavate, 4-sterigmate, 14-20 x 3-4.5 μm, wall thickened toward the base, simple-septate at the base; basidiospores oblong-ellipsoid, hyaline, thin-walled, negative in Melzer's reagent, 3-4 x 2-2.5 μm. 20807, on *C.*

chamissoi, Stainback Highway. In keys to *Hymenochaete* species by Burt (1918) and Reeves and Welden (1967) the taxa nearest to this would be *H. anomala* Burt and *H. multisetae* Burt. However both have allantoid to suballantoid spores, quite different from the oblong-ellipsoid spores of *H. tomentelloidea*.

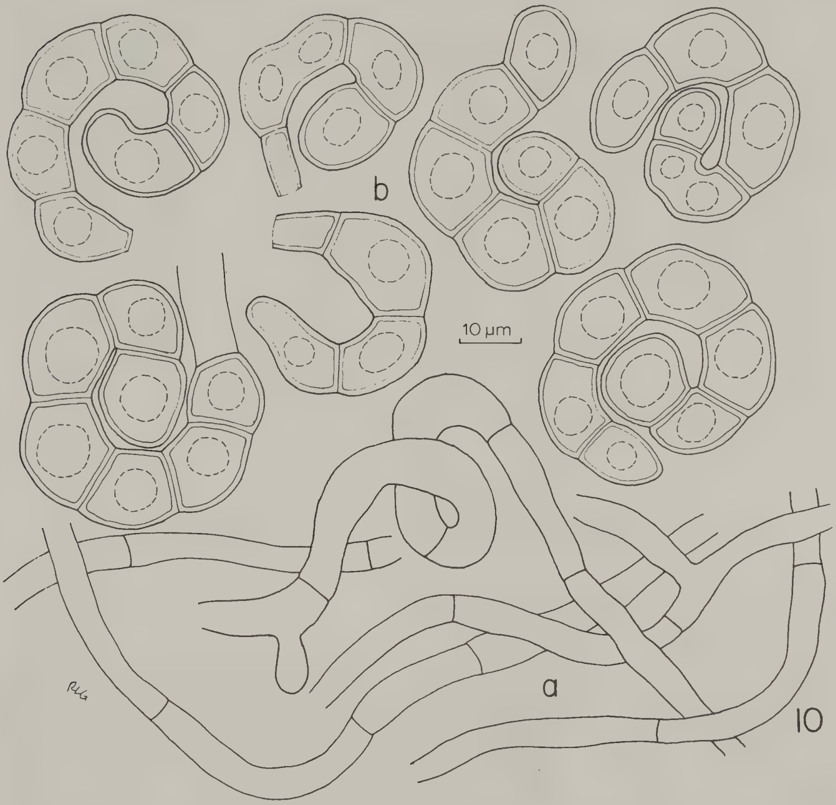


Fig. 10. Hobsonia gigaspora (RLG 17025). a, vegetative hyphae; b, conidia.

HYPHODERMA NUDICEPHALUM Gilb. & M. Blackwell Fig. 12
Mycotaxon 33:378. 1988.

Basidiocarps annual, resupinate, effused up to 6 cm, soft and easily separated from substratum; hymenial surface Light Olive-Gray, smooth to slightly tuberculate with short, scarcely differentiated aculei on a porose, smooth hymenium; margin thinning out; hyphal system monomitic; subicular hyphae hyaline, thin-walled, with clamps at all septa, 2-4 μm in diam, with frequent branching, especially from the clamps; cystidia scattered but frequent, especially at apices of the small aculei, cylindric, thin-walled, septate with clamps, 50-120 x 7-9 μm, lightly to heavily incrusted with coarse crystalline material, apex swollen up to 14 μm, without incrustation; basidia in loose candelabra, narrowly clavate, 4-sterigmate, 16-22 x 5-7 μm, with a basal clamp: basidiospores cylindric-ellipsoid, slightly curved, hyaline, smooth, thin-walled, negative in Melzer's reagent, 7-9 x 3-4 μm. 20445A, on *Cibotium* sp., Kalopa State Park. This taxon, described from the Gulf Coast Region, has not been previously reported from Hawai'i.

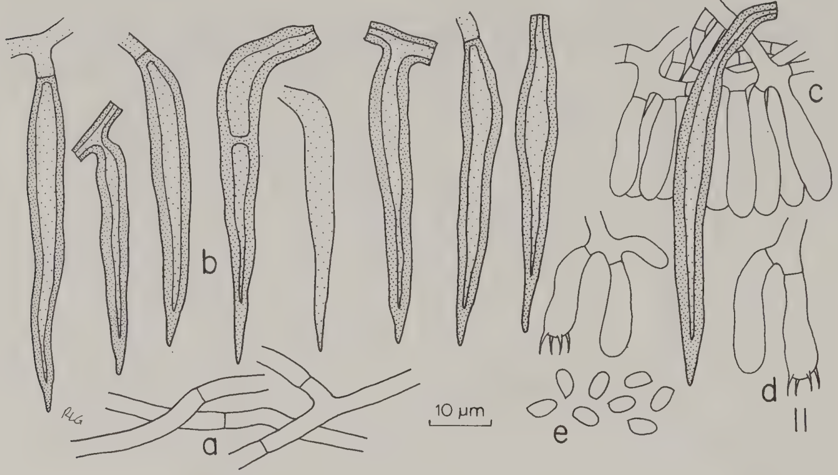


Fig. 11. *Hymenochaete tomentelloidea* (RLG 20807). a, subicular hyphae; b, setae;, hymenium with seta; d, basidia; e, basidiospores.

HYPHODONTIA ALUTARIA (Burt) J. Erikss. Fig. 13
Symb. Bot. Upsal. 16:1 p. 104. 1958.
Basidiocarps annual, resupinate, thin and farinaceous, hymenial surface discontinuous, smooth to finely tuberculate or grandinioid, pale buff; hyphal system monomitic; subicular hyphae thin- to firm-walled, with clamps and frequent branching, 2-3.5 μm in diam; lagenocystidia numerous, with an apically incrusted narrow upper part; capitate to moniliform cystidia also conspicous, with basal and often intermediate clamps, thin-walled, 2-3 μm in diam and projecting up to 35 μm beyond the basidia; basidia cylindric-clavate with a median constriction, 4-sterigmate, 15-18 x 4.5-5 μm, with a basal clamp; basidiospores broadly ellipsoid to subglobose, hyaline, smooth, negative in Melzer's reagent, 3.5-4.5 x 4-5 μm. 17197, on *Cibotium* sp., Kalopa State Park. This is a widely distributed taxon but not previously reported from Hawai'i.

HYPOCHNICIUM PUNCTULATUM (Cooke) J. Erikss. Fig. 14
Symb. Bot. Upsal. 16:1. p. 101. 1958.
Basidiocarps annual, resupinate, effused up to 7 cm, membranous, soft and easily separated; hymenial surface smooth, cream colored, cystidiate under a 30x lens; hyphal system monomitic; subicular hyphae hyaline, thin- to firm-walled, closely septate with a clamp at all septa, often branching repeatedly from clamps, 3.5-5 μm in diam; cystidia abundant, thin-walled, 60-80 μm long, with a broad base up to 16 μm wide, tapering gradually to an acute or rounded tip, apex often with a gummy, amorphous incrustation; basidia narrowly clavate, 4-sterigmate, 25-30 x 6-7 μm, with a basal clamp;

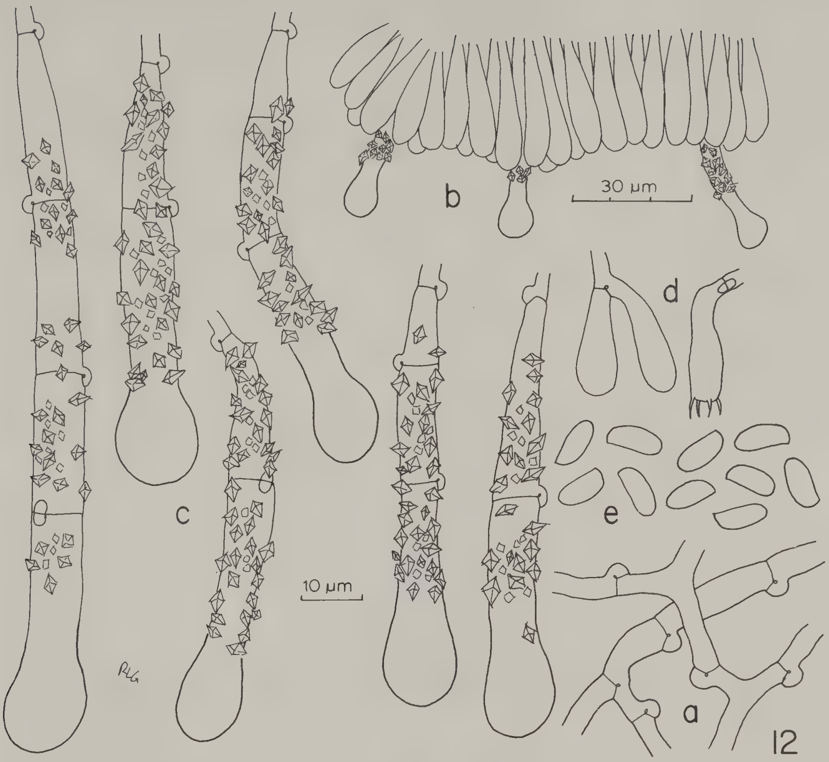


Fig. 12. *Hyphoderma nudicephalum* (RLG 20445A). a, subicular hyphae; b, schematic drawing of hymenium with cystidia; c, cystidia; d, basidia, e, basidiospores.

basidiospores broadly ellipsoid to subglobose, hyaline, thick-walled, finely verrucose, negative in Melzer's reagent, 5-6.5 x 4-5.5 μm. 20450, on *C. chamissoi*, Dolphin Bay Hotel, Hilo, South Hilo District, Hawai'i. Previously reported from Hawai'i by Gilbertson and Adaskaveg (1994) on *Eugenia jambos* L. on Maui. The specimen on *Cibotium* has cystidia that differ from those illustrated for specimens from Europe (Eriksson and Ryvarden, 1976) and North America (Gilbertson and Blackwell, 1987) in having a relatively broader base and often having apical incrustation.

LACHNELLA GLEICHENIAE (Cash) Seaver Fig. 15
North Am. Cup Fungi. (Inoperculates), p. 266. 1951.
Apothecia stalked, up to 1 mm tall, cup up to 1 mm wide, outer surface matted-woolly with golden orange beads of exudate giving it an orange-yellow color when fresh; hyphae of wooly outer surface appearing rough from fine incrustation, septate. 3-4 μm in diam, often with an inflated basal cell; hymenial paraphyses lanceolate, smooth, 50-60 x 3-3.5

μm; asci narrowly clavate, 8-spored, 45-50 x 4-5 μm, the spores crowded in the apical half at maturity; ascospores fusiform, hyaline, smooth, negative in Melzer's reagent, 11-12.5 x 1.5-2 μm. 18072, on *C. glaucum*, kīpuka at mile 18, Saddle Rd. Cash (1938) and Seaver (1951) report this fungus from Hawai'i on tree ferns.

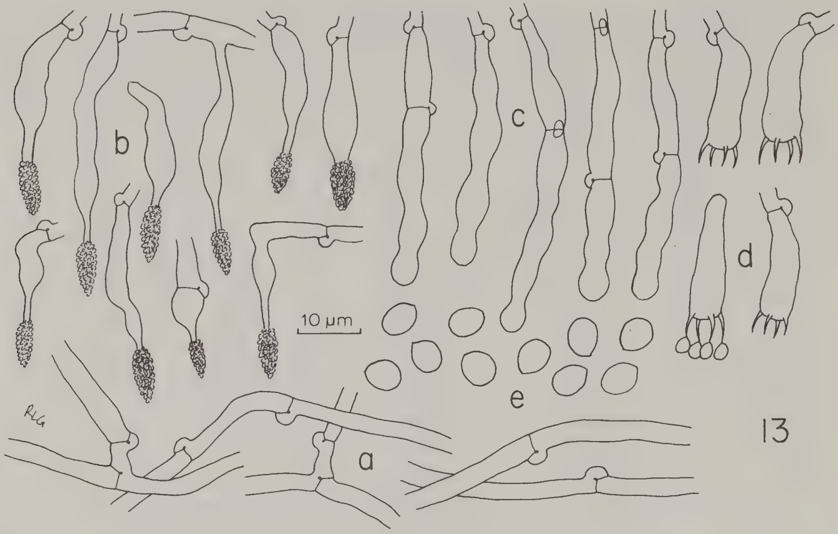


Fig. 13. *Hyphodontia alutaria* (RLG 17197). a, subicular hyphae; b, lagenocystidia; c, capitate and moniliform cystidia; d, basidia; e, basidiospores.

LYCOGALA EPIDENDRUM L.: Fr.
Syst. Mycol. 3:80. 1829.
Eliasson (1991) reported *L. epidendrum* from the Hawaiian Islands and states that some Hawaiian collections intergrade with *L. exiguum* Morgan. The spores of our collection are small (5-6 μm in diam) for *L. epidendrum* and are more typical of *L. exiguum*. The strongly sculptured and wide (up to 15 μm) pseudocapillitium and non-tessellate peridial scales are characteristic of *L. epidendrum*. 20445B, on *Cibotium* sp., Kalopa State Park. This cosmopolitan myxomycete is rather common on woody substrates in Hawai'i.

LYCOPERDON PERLATUM Pers.: Fr.
Syst. Mycol. 3:37. 1829.
DEH 1172, on trunk of living *C. glaucum*, Kilauea Iki, HVNP, Ka'ū Dist., Hawaii.

PHLEBIELLA TULASNELLOIDEA (Höhn. & Litsch.) Oberw.
Bibl. Mycol. 61:343. 1977.
Basidiocarps annual, resupinate, effused up to 10 cm., appearing as a thin waxy film, easily scraped from substrate; hymenial surface smooth, Light Neutral Gray to Light Gull Gray; hyphal system monomitic; subicular hyphae collapsed, agglutinated, and difficult

to discern in dried specimens, obscure clamps present; cystidia or other sterile hymenial elements absent; basidia broadly clavate to obovoid, often pleural but base of basidium usually obscured in the agglutinated mass of collapsed subhymenial hyphae, 4-sterigmate, 10-13 x 6-7 μm, sterigmata up to 6 μm long; basidiospores broadly ellipsoid to subglobose with a concave face (which may or may not be evident depending on the aspect of the spore viewed), finely echinulate or verrucose, 4.5-6 x 3.5-4.5 μm. 20802, on *C. chamissoi*, Stainback Highway. Extremely common on many woody substrates in Hawai'i (Liberta, 1960; Gilbertson and Adaskaveg, 1993) but not previously reported on tree ferns.

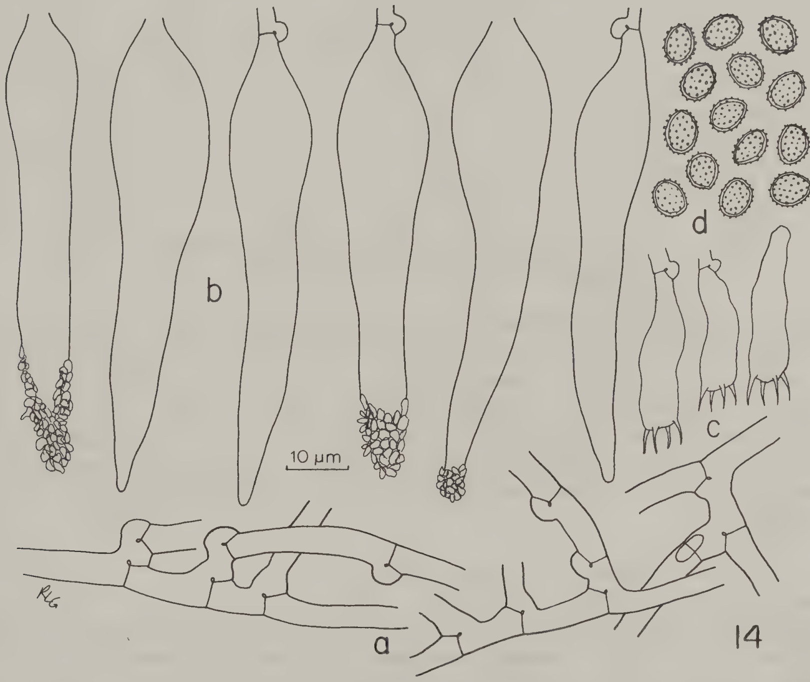


Fig. 14. *Hypochnicium punctulatum* (RLG 20450). a, subicular hyphae; b, cystidia; c, basidia; d, basidiospores.

RESINICIUM BICOLOR (Fr.) Parmasto Fig. 16
Conspectus Syst. Cort. p. 98. 1968.

Basidiocarps annual, resupinate, effused up to 5 cm, adherent; hymenial surface cream-colored, with small to well-developed, widely spaced, conical aculei up to 200μm long, smooth surface porose and deeply cracked to reveal a thin, arachnoid subiculum; hyphal system monomitic; subicular hyphae hyaline, thin-walled, collapsed and agglutinated in dried specimens, with obscure clamps, 2-3 μm in diam; sterile hymenial elements of two types, some usually called halocystidia or haloed cystidioles, these capitate with a thin-walled spherical sac or halo, capitate apex 6-12 μm in diam, halo 12-27 μm in diam, stalk portion 1.5-2 μm in diam, 15-20 μm long with an obscure basal clamp; others

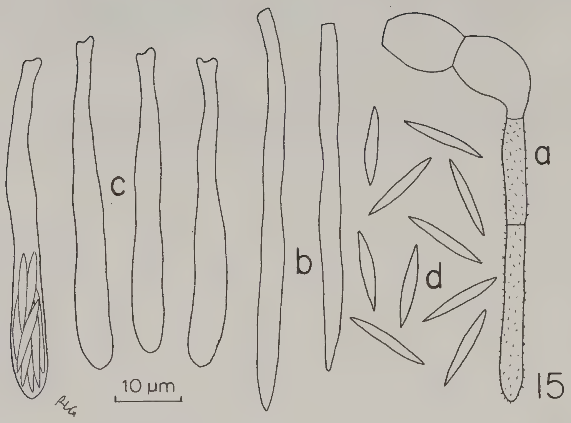
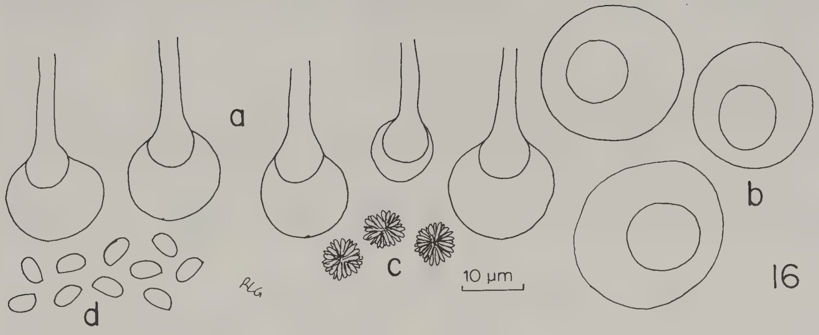


Figure 15. *Lachnella gleicheniae* (RLG 18072). a, abhymenial surface hypha with inflated basal cells; b, paraphyses; c, asci; d, ascospores.

called astrocystidia, with terminal cluster of crystals arranged in radial fashion to form a star-like cluster 5-7 µm in diam; subulate hyphoid elements projecting at apices of aculei; basidia clavate, 4-sterigmate, 12-14 x 4-5 µm, with a basal clamp; basidiospores ellipsoid, hyaline, smooth, thin-walled, negative in Melzer's reagent, 5-6 x 2.5-3 µm. 20804, on *C. chamissoi*, Stainback Highway. This is one of the most common wood-rotting fungi in Hawai'i on many substrates, but not previously reported on tree ferns. Reported from Hawai'i on *Trema orientalis* (L.) Blume by Gilbertson and Adaskaveg (1993).

SCHIZOPORA FLAVIPORA (Cooke) Ryvarden
Mycotaxon 23:186. 1985.
Basidiocarps annual, resupinate, very thin, with shallow, cupulate, regular tubes; pore surface Cream Color to Pale Buff, pores regular, angular, 3-5 per mm, with minutely fimbriate dissepiments; subiculum cream colored, very thin (25-45 µm thick), soft and floccose; hyphal system monomitic; subicular hyphae loosely arranged, hyaline, thin-walled, with frequent branching, with clamps at all septa, heavily to loosely incrusted with coarse crystalline material, 2-3 µm in diam; cystidia absent, some fusoid to capitate cystidioles present; basidia suburniform with a median constriction, 15-20 x 4-5 µm; basidiospores ellipsoid, hyaline, smooth, negative in Melzer's reagent, 4.5-5.5 x 3-3.5 µm in diam. 17360, 18665, 20444, on *Cibotium* sp., Kalopa State Park; 18256, on *C. chamissoi* sp., Honokaia Boy Scout Camp, Highway 19. A widely distributed fungus in temperate and subtropical areas of the world. The extremely shallow tubes and thin subiculum are deviant characters but this is a highly variable taxon. Reported from Maui on *Eucalyptus* sp. by Gilbertson and Adaskaveg (1993).

SCYTINOSTROMA HEMIDICHOPHYTICUM Pouzar Fig. 17
Česka Mykol. 20:217. 1966.
Basidiocarps annual, resupinate, effused up to 10 cm, tough-fibrous; hymenial surface



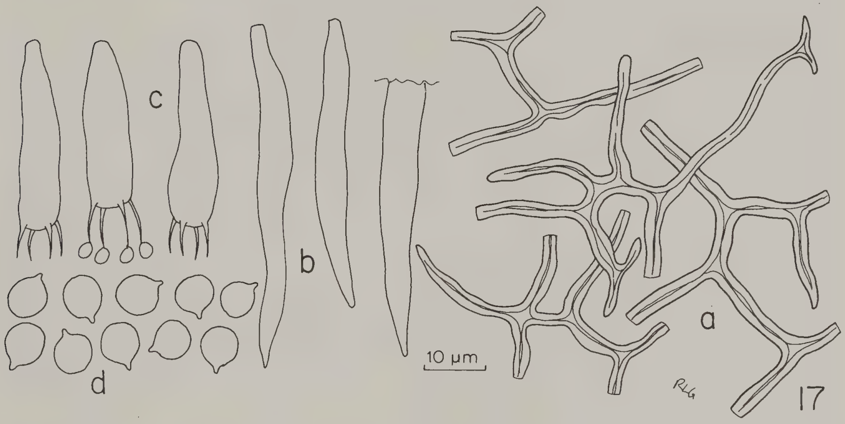
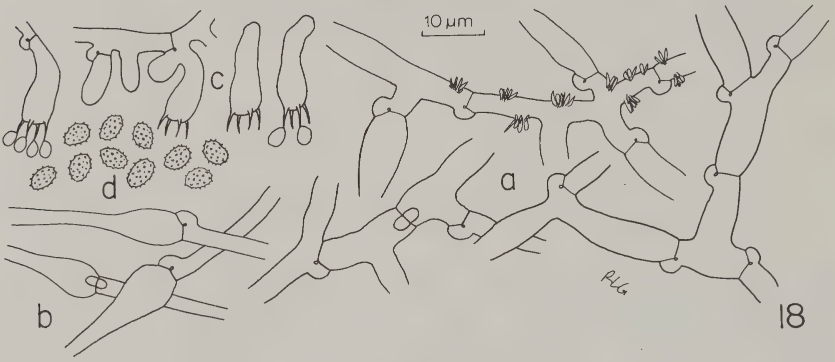


Fig. 16. *Resinicium bicolor* (RLG 20804). a, upper part of haloed cystidioles; b, top view of haloed cystidioles; c, stellate crystal clusters; d, basidiospores. Fig. 17. *Scytinostroma hemidichophyticum* (DEH 858). a, dendrohyphidia; gloeocystidia; c, basidia; d, basidiospores.

smooth, Cartridge-Buff to Chamois where bruised or broken, margin abrupt, adherent or curling away from the substrate on drying; subiculum Cinnamon-Buff to Chamois, basal part faintly zonate with thin, darker layers, up to 2 mm thick; tissue instantly turning dark reddish-brown in Melzer's reagent; hyphal system with generative hyphae and dendrohyphidia; generative hyphae obscure, thin-walled, hyaline, simple-septate, 1-2 µm in diam; dendrohyphidia the predominant element in subiculum, hyaline, thick-walled, nonseptate, strongly dextrinoid, basically with dendritic branching, but tending to branch dichotomously at the tips, 2-3 µm in diam, ultimate branches tapering to slender tips less than 1 µm in diam; gloeocystidia abundant, acuminate, thin-walled, 40-60 µm long, 5-7 µm at the base, tapering to an acute apex, projecting 20-40 µm; basidia narrowly clavate with a swollen base, 2-4 sterigmate, 30-40 x 6-7 µm; base obscured; basidiospores globose to subglobose, hyaline, smooth, weakly amyloid in Melzer's reagent, 5.5-6.5 µm in diam, with a prominent apiculus. DEH 858, on *C. glaucum*, Pu'u Maka'ala, Puna District, Hawai'i. Our specimen agrees well with the description and illustrations by Boidin and Lanquetin (1987). Not previously reported from Hawai'i.

TRECHISPORA FARINACEA (Pers.: Fr.) Liberta Fig. 18
Taxon 15:318. 1966.

Basidiocarps annual, resupinate, effused up to 15 cm; hymenial surface white to cream colored, farinaceous, soft and fragile and easily flaked off the substratum; subiculum an extremely thin, fragile, discontinuous, arachnoid layer, the hymenial surface resembles a farinaceous coating over the meshes of a loose net; margin abrupt or thinning out to radiating hyphal strands; hyphal system monomitic; subicular hyphae hyaline, thin-



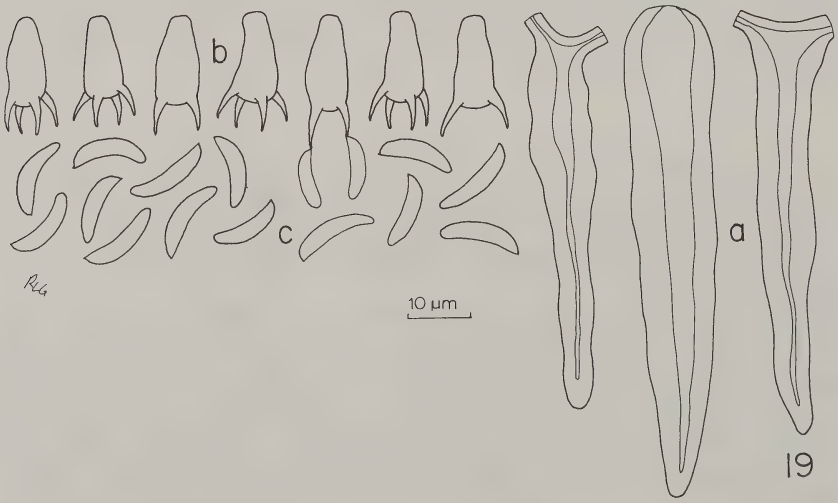


Fig. 18. *Trechispora farinacea* (RLG 17270). a, subicular hyphae; b, strongly ampullate subicular hyphae; c, basidia; d, basidiospores. Fig. 19. *Tubulicium dussii* (RLG 17024). a, cystidia; b, basidia; c, basidiospores.

walled, closely septate, with clamps, often ampullate at the septa, frequently branched,2-8 μm in diam, some heavily to lightly incrusted with irregular to short, rod-like crystals; cystidia absent; basidia clavate, 2-4 spored, 10-15 x 4-5 μm, with a basal clamp; basidiospores ovate to ellipsoid, hyaline, finely but distinctly verrucose, negative in Melzer's reagent, 3.5-4.5 x 2.5-3 μm. 17270, 18071, on *C. glaucum*, kīpuka at mile 18, Saddle Road; 20800, on *C. chamissoi*, Stainback Highway. Common species on woody substrates throughout Hawai'i. Reported from Hawai'i on *Metrosideros polymorpha* Gaud. and *Terminalia catappa* L. by Gilbertson and Adaskaveg (1993).

TUBULICIUM DUSSII (Pat.) Oberw. ex Jülich Fig. 19
Persoonia 10:335. 1979.
Basidiocarps annual. resupinate, developing as a thin film in small patches or effused up to 6 cm; hymenial surface appearing smooth to the naked eye, minutely but densely cystidiate under a 30x lens, Cream Color to Cartridge Buff, margin abrupt; hyphal system monomitic, subicular hyphae difficult to discern, apparently simple-septate or with occasional clamps, 2-2.5 μm in diam; cystidia abundant, narrowly conical and tapering to a point, thick-walled, rooted at the base, hyaline, with a sheath of minute, densely branched hyphae, 60-85 x 9-15 μm; basidia stoutly clavate, 4-sterigmate, 13-15 x 6-8 μm, simple-septate at the base, the sterigmata up to 6 μm long and 2 μm in diam at the base; basidiospores lunate to navicular, hyaline, smooth, negative in Melzer's reagent, 10-14 x 2-3 μm. 17013, 17014, 17018, 17024, 17262, 17264, 17277, on *C. glaucum*, kīpuka at mile 18, Saddle Rd.; 20938B, on *C. glaucum*, 20946, 20956, on *C. chamissoi*, kīpuka at mile 10.5, Saddle Rd.; 17033, on *C. chamissoi*, Volcano Dump, Highway 11, Puna Dist., Hawai'i; 17197A, 18645, 18646, 20446 on *C. chamissoi*, Kalopa State Park; 17528, 17578, 17857, 18257, on *C. chamissoi*, Honokaia Boy Scout Camp, Highway 19; 20799, on *C. chamissoi*, Stainback Highway. Boquiren (1971) reported this fungus on *C. chamissoi* and listed a number of collections by D.P. Rogers from O'ahu and Hawai'i. In our experience, *T. dussii* and *Athelia cibotii* are the two most common fungi on Hawaiian tree ferns.

VARARIA sp.
Basidiocarps annual, resupinate, developing in small, scattered patches, these becoming confluent and effused up to 15 cm; hymenial surface smooth, Marguerite Yellow to Cream-Buff, margin abrupt; hyphal system dimitic; generative hyphae difficult to discern in the subiculum, apparently simple-septate as are hyphae in the substrate under the basidiocarp, 2-3 μm in diam; skeletal hyphae thick-walled, nonseptate, dextrinoid in Melzer's reagent; in KOH and phloxine the abundant brightly staining vesicular elements are conspicuous in the subiculum, these apparently basidia and/or gloeocystidia; dichohyphidia abundant, small and intricately branched, dextrinoid in Melzer's reagent; no mature sterigmate basidia or basidiospores seen. Macroscopically this taxon looks like *V. gomezii*, which Gilbertson and Adaskaveg (1993) reported from Hawai'i. However, the microstructure of *V. gomezii* is different. This appears to be a species distinct from any included here but in the absence of information on basidia and basidiospores we simply record the available morphological data. 16964, on *C. chamissoi* in residential planting, Hilo, South Hilo Dist., Hawai'i; 18408, 18415, on *Angiopteris evecta* (mulefoot fern), Manoa Falls Trail, Honolulu Dist., O'ahu.

VARARIA MICROHYPHIDIA Gilb. & Hemmes, sp. nov. Fig. 20

Fructificatio annua, resupinata, tenuissima, mollis; superficies hymenii laeves, pallido roseo-cinnamomea vel bubalina; hyphae generaticae fibulatae, inconspicua; dichohyphidia minutae, multiramosae, dextrinoidea; gloeocystidia elongata, capitata, 40-55 μm longae, 2-5 μm diam; basidia clavata vel suburniforma, 4-sterigmatica, 20-30 x 6-7 μm; basidiosporae ellipsoidae vel navicularae, laevis, hyalinae, nonamyloidae, 7.5-8.5 μm. Holotypus (BPI): RLG 18942, on *C. chamissoi*, Honokaia Boy Scout Camp, Hamakua Dist., Hawai'i.
Etymology: from the minute dichohyphidia.

Basidiocarps annual, resupinate, appearing as a thin film with occasional denser areas but apparently with virtually no subiculum at all, developing in small confluent patches and becoming confluent up to 15 cm, adherent but soft and easily scraped from substrate; hymenial surface Pale Pinkish Cinnamon to Cartridge Buff, smooth, margin abrupt, fertile to the edge; hyphal system with generative hyphae and dichohyphidia; generative hyphae difficult to discern, hyaline, thin-walled, with obscure clamps, 2-3 μm in diam; dichohyphidia in extremely fine, much branched clusters about 10-20 μm wide, weakly to moderately dextrinoid, branches less than 1 μm in diam; gloeocystidia frequent, thin-walled, capitate, 40-55 μm long and projecting to 30 μm, basal part up to 5 μm in diam, narrow neck 1.5-2.5 μm in diam, swollen apex spherical, 5-7 μm in diam; basidia clavate or slightly swollen at the base, 4-sterigmate, 20-30 x 6-7 μm, basal septation obscure; basidiospores ellipsoid to navicular, hyaline, smooth, thin-walled, negative in Melzer's reagent, 7.5-8.5 x 3.5-5 μm, often adhering in groups of 2-4. 18942 (TYPE), on *C. chamissoi*, Honokaia Boy Scout Camp. The extremely fine dichohyphidial clusters, conspicuous capitate cystidia, and spores often adhering in groups are the diagnostic

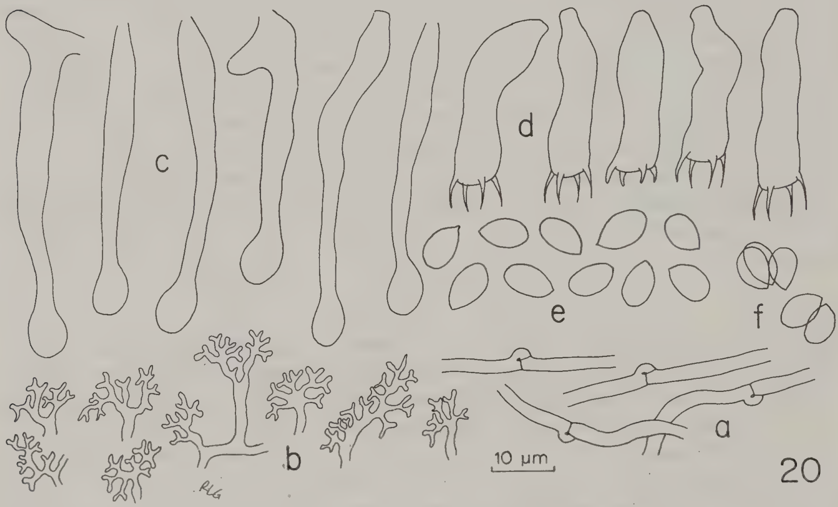


Fig. 20. *Vararia microhyphidia* (RLG 18942). a, subicular generative hyphae; b, dichohyphidia; c, gloeocystidia; d, basidia; e, basidiospores; f, basidiospores adhering in groups.

characters of this species.

ACKNOWLEDGMENTS

We thank the curators of the herbaria at the University of Tennessee and The New York Botanical Garden for the loan of specimens used in this research. Also, mahalo to Dennis Desjardin, Jack Rogers, and George Wong for the pleasure of their company in the kīpukas and on the trails of the Hawaiian Islands.

LITERATURE CITED

BAKER, G. 1936. A study of the genus *Helicogloea*. Ann. Missouri Bot. Gard. 23:69-114 + 14 pl. **BECKER, R.** 1984. The identification of Hawaiian tree ferns of the genus *Cibotium*. Amer. Fern J. 74(4):97-100. **BODMAN, M.C.** 1952. A taxonomic study of the genus *Heterochaete*. Lloydia 15:193-233. **BOIDIN, J. and P. LANQUETIN.** Le Genre *Scytinostroma* Donk. (Basidiomycètes, Lachnocladiaceae). Bibliotheca Mycol. 114:1-130. **BOQUIREN, D.T.** 1971. The genus *Epithele*. Mycologia 63:937-957. **BURT, E.A.** 1918. The Thelephoraceae of North America. X. *Hymenochaete*. Ann. Mo. Bot. Gard. 5:301-372. **BURT, E.A.** 1923. Higher fungi of the Hawaiian Islands. Ann. Missouri Bot. Gard. 10:179-189. **CASH, E.K.** 1938. New records of Hawaiian discomycetes. Mycologia 38:97-107. **ELIASSON, U.H.** 1991. The myxomycete biota of the Hawaiian Islands. Mycol. Res. 95:257-267. **ERIKSSON, J. and L. RYVARDEN.** 1976. The Corticiaceae of North Europe. Vol. 4. *Hyphodermella-Mycoacia*. p. 547-886. Fungiflora, Oslo, Norway. **FARR, D.F., G.F. BILLS, G.P. CHAMURIS, and A.Y. ROSSMAN.** 1989. Fungi on Plants and Plant Products in the United States. APS Press, St. Paul. Minnesota. 1252 p. **GILBERTSON, R.L. and J.E. ADASKAVEG.** 1993. Studies on wood-rotting Basidiomycetes of Hawaii. Mycotaxon 49:369-397. **GILBERTSON, R.L. and M. BLACKWELL.** 1987. Notes on wood-rotting fungi on junipers in the Gulf Coast region. II. Mycotaxon 28:369-402. **JÜLICH, W.** 1972. Monographie der Atheliae (Corticiaceae, Basidiomycetes). Willdenowia 7:1-281. **JÜLICH, W.** 1975. Studies in resupinate basidiomycetes- III. Persoonia 8:291-305. **LIBERTA, A.E** 1960. A taxonomic analysis of section *Athele* of the genus *Corticium*. I. Genus *Xenasma*. Mycologia 52:884-914. **LINDER, D.H.** 1929. A monograph of the helicosporous Fungi Imperfecti. Ann. Missouri Bot Gard. 16:227-338. **MARTIN, G.W.** 1937. New or noteworthy fungi from Panama and Columbia. I. Mycologia 29:618-625. **MARTIN, G.W.** 1959. On the genus *Hobsonia*. Brittonia 11:98-101. **OBERWINKLER, F.** 1965. Primitive Basidiomyceten. Revision einiger Formenkreise von Basidienpilzen mit plastischer Basidie.. Sydowia, Ann. Mycol. Ser. II, 19:1-72 + 21 pl. **OLIVE, L.S.** 1958. The lower basidiomycetes of Tahiti- I. Bull. Torrey Bot. Club 85:5-27. **RAABE, R.D., I.L. CONNERS, and A.P. MARTINEZ.** 1981. Checklist of plant diseases in Hawaii. Hawaii Inst. Trop. Agric. Hum. Res., Hawaii Inform. Text Ser. 022:1-313. **REEVES, F., Jr. and A.L. WELDEN.** 1967. West Indian species of *Hymenochaete*. Mycologia 59:1034-1049. **RIDGWAY, R.** 1912. Color Standards and Nomenclature. Published by the Author. Washington, D.C. **SEAVER, F.J.** 1951. The North American Cup-Fungi (Inoperculates). Hafner Publishing Co., New York. 428 p. **WAGNER, W.H.** 1990. Hawaii's satchel-sorus tree ferns, *Cibotium* species: what is their taxonomic status? Amer. Fern Soc. Newsletter 17:7-8. **WELLS, K.** 1959. Studies of some Tremellaceae. III. The genus *Bourdotia*. Mycologia 51:541-563.

MYCOTAXON

Volume LXII, pp. 489-493 April-May 1997

BOOK REVIEWS

D. S. Hibbett, Book Review Editor

Sferiacei Italici. Centuria I, by Giuseppe De Notaris. Softcover, 240 x 170 mm, 128 pp., 102 figures, 1995. Accademia Nazionale Delle Scienze Detta Dei XL, 00144 Roma, Palazzo della Civilta, Quadrato della Concordia. ISSN 03-91-4666.

This reprint of **Sferiacei Italici. Centuria I** was produced by the National Academy of Sciences to honor one of its own. The body of this volume is a reprint of the text and figures of De Notaris's 1863 work in Italian and Latin, with figures slightly reduced from the original. With its emphasis on microscopic characteristics, this work is an important early contribution to ascomycete systematics. In this volume of Hypocreaceae and Sphaeriaceae, De Notaris treated 101 species and one variety, with 46 species and one variety described as new. The illustrations of 100 taxa provide a useful visual reference for microscopic fungi at a time when few fungi were ever illustrated. A number of these illustrations are for taxa that were described by Cesati and De Notaris in the **Schema di classificazione degli Sferiacei Italici** in 1863. De Notaris provided the mycological expertise in the collaboration with Cesati and a number of the early important generic names still in use today (e.g. *Lasiosphaeria, Leptosphaeria, Lophiostoma, Sordaria*) were established by them in the **Schema**. The **Sferiacei Italici**, sole authored by De Notaris, is a reflection of his contribution to mycology and it is fitting that it should be reprinted to honor him. To provide easier access to important early mycological texts, I can't help but wish that the **Schema** had also been reprinted.

The remainder of the volume, presented in Italian and English, includes the Introduction and Remarks contributed by A. Graniti. Also given is an Index to genera, species and synonyms and an Errata Corrige of some misprints found in the text during compilation. The introduction is a short biography and history including some of the tribulations of getting work published in the mid nineteenth century. I found it interesting reading and wished additional information about De Notaris had been translated from some of the cited Italian literature. The appendix, by L. Zucconi and Graniti, is an annotated checklist of **Sferiacei Italici** exsiccati that exist in the general herbarium at RO. Recorded are notes from the herbarium specimens, including types, subsequent determinations and current name usage when known.

In addition to access to the necessary original descriptions these works provide, I find the illustrations of older works very helpful for comparing earlier concepts of genera with those of the present day. This a useful addition to the library of early mycological works now available to the current generation of mycologists and it takes its place alongside the reprint volumes of Berlese's **Icones Fungorum** and other similar works. *Sabine M. Huhndorf, Botany Department, Field Museum, Chicago, IL 60605.*

Monographie des *Leccinum* d'Europe, by Gilbert Lannoy and Alain Estades. 230 x 245 mm, 229 pp. Fédération Mycologique Dauphiné-Savoie, Maison Forestière, Rognaix 73730 Cevins, France. Tel: 79-38-25-45.

This book is devoted to a taxonomic treatment of the European species of *Leccinum*, a bolete genus often thought to be one of the more difficult and variable taxa in the order Boletales. It is rare that one encounters a book so handsomely crafted and user-friendly as this one. The large format made it possible to put a complete species description on opposing pages. It appears to be soundly constructed with a hard cover and firm binding, and it was printed on very thick paper—so thick in fact that I often had to check to be sure that I was not turning two pages instead of one. The print is small but is crisp, clear and easy to read. Although written in French, the authors seem to have made an effort to keep the terminology of the descriptions as simple as possible.

There are forty-six taxa, including thirty-six species, three varieties and seven forms with detailed descriptions of each. These are supplemented by a few taxa that are only given short comments and are not included in the keys or illustrations. So far as could be determined this is the largest number of species of *Leccinum* ever reported from Europe. Even so, three additional species, *L. cervinum, L. palustre*, and *L. populinum*, reported from Finland in 1995 by Kohonen, were not included.

At the beginning of the monograph, after the introduction and acknowledgments, there is a detailed description of the genus *Leccinum* and comments on its taxonomic history. This is followed by a discussion of the characters used in formulating the descriptions and comments about the chemical reagents used in identifying species. There are also several tables included that summarize data on mycorrhizal relationships, distribution and edibility.

The taxonomic keys are traditional in their approach and employ such characters as pileus color, color changes that may occur when the context is exposed, mycorrhizal hosts, features of the cuticle and cystidia and, to a lesser extent, reactions of the context with various reagents. Some readers may feel that color is overemphasized and may also have some reservations regarding the occasional use of "small" versus "large" in reference to the pileus without giving any measurements. However, those familiar with the genus are aware that such characters have been commonly used in previous keys and descriptions. The authors have prepared keys to the genera of the Boletales as well as a field key based largely on macroscopic characters and an analytical key that makes use of the above characters as well as features of the cutis, cystidia and sphaerocysts. They were also thoughtful enough to have included a key to species in English.

The descriptions are formulated in the usual manner by first presenting their synonomy, if any, followed by an innovation not seen before by this reviewer, namely the inclusion of a verbatim copy of the type description. Next is an account of the macroscopic characters followed by the microscopic characters and finishing with the usual data on habitat, distribution, mycorrhizal associates, specimens studied and comments. The descriptions are adequate but not overly detailed, particularly those of the microscopic characters. Data on habitat and distribution are likewise brief with few, if any, comments on such features as growth habits and soil preferences. Also included are line drawings of the epicutis, spores and cystidia for each species.

The forty-six taxa reported for the entire European continent seems small when in North America the state of Michigan alone has fifty-six species. It is interesting to note that the authors have either described as new or made new combinations of twenty of the forty-six taxa even though the genus has been known in Europe for a very long time. It is also interesting that there are only eight species common to North America and Europe although mycorrhizal hosts and climates are reasonably similar.

The magnificent aquarelles of forty-five of the taxa are the most impressive and delightful feature of this publication. Each plate presents several basidiomata, depicting their variation in color, size and color changes in context upon exposure.

It is a pleasure to recommend this publication without reservation to everyone interested in the boletes or fleshy fungi. *Harry D. Thiers, 9013 N. Picture Ridge Road, Peoria, IL 61615.*

Fungi of Australia Volume 1A, Introduction—Classification, Edited by A. E. Orchard, C. Grgurinovic, and K. Mallett. Softcover, 245 x 175 mm, 413 pp. ISBN 0-643-05889-3. $US 54.95. **Fungi of Australia Volume 1B, Introduction—Fungi in the Environment**, Edited by A. E. Orchard, K. Mallett, and C. Grgurinovic. Softcover, 245 x 175 mm, 405 pp. ISBN 0-643-05936-9. $US 54.95. CSIRO Publishing, 150 Oxford St., P.O. Box 1139, Collingwood 3066, Victoria, Australia. Fax: 61 3 9662 7555, internet: http://www.publish.csiro.au.

The **Fungi of Australia** series was derived from the **Flora of Australia** project, which began in 1981 and has already produced seventeen volumes. Sixty volumes are planned in the **Fungi of Australia** series, which makes this one of the most ambitious mycological projects ever.

Almost all organisms that have traditionally been studied by mycologists will be included in the **Fungi of Australia**, including Myxomycetes and Oomycetes, which are clearly not members of the monophyletic Eumycota. Unfortunately, lichens are being treated in the **Flora** series (vols. 54-55 on lichens have already been published), but keys in the **Fungi** series will include lichens. The next two volumes are a "Bibliographic checklist of macrofungi" and "Keys to macrofungi." These will need revision by the time the series is complete, but are "intended to provide interim identification aids and basic bibliographic tools for the most conspicuous group of fungi." The fourth volume, "Habitat-based taxonomic treatments" is also designed to aid identification. Detailed taxonomic treatments will begin with volume 5, on Protoctista.

Volume 1 of the **Fungi of Australia** provides background for the subsequent volumes, but it can stand on its own as a review of fungal taxonomy and ecology. Australian fungi are emphasized throughout, but they are discussed in a general mycological context. Volume 1A is primarily concerned with higher-level taxonomy. Chapter 1, "The classification of the fungi: history, current status and usage in the **Fungi of Australia**," provides an overview of the classification and a historical review of taxonomic mycology, from the work of Micheli and earlier to the present. Chapter 2 contains a key to orders, and chapter 3 is an extensive bibliography of taxonomic mycology. Chapter 4 is an interesting, detailed account of the "History of the taxonomic study of Australian fungi," which, of course, involves a number of European and American mycologists, such as Berkeley and Lloyd. Chapter 5, "Biology of fungi," briefly reviews growth and development, nutrition, physiology, genetics, and life cycles of the polyphyletic group of "fungi" treated in the series. Compared to the other, more narrowly focused chapters, chapter 5 lacks depth and is not as useful a review. Chapter 6, "Biogeography of fungi with special reference to Australia," discusses factors affecting fungal distribution, including plate tectonics, and describes examples of fungal distributional patterns. This chapter presents hypotheses that could be tested in phylogenetic studies of fungal biogeography. Chapter 7, "The fossil record of the fungi in Australia and the Australasian region," complements chapter 6, and contains references that may not be widely cited in American and European works. For example, this chapter mentions a putative Triassic polypore, *Eopolyporoides kukleyi*, that I have not seen cited elsewhere. Conspicuously absent from vol. 1A is a review of fungal molecular systematics. Although there are passing references to this subject in Chapter 1, there is not one phylogenetic tree. One hopes that later volumes on specific groups will thoroughly discuss the impact of recent phylogenetic studies.

Volume 1B emphasizes environmental biology of fungi and interactions of fungi with other organisms. Many of the chapters follow a similar general format in which the characteristics of the environment are described first, followed by a taxonomic account of the fungi and associated organisms. This organization is used for chapters on "Freshwater fungi," "Marine fungi," "Wood decay fungi," "Associations between arthropods and fungi," "Gut-inhabiting fungi of Australian herbivores," and "Fungi as a food resource for mammals in Australia." These chapters will be especially useful to ecologists and others with interests centered on habitats rather than particular fungal taxa. Fungal pathogens are discussed in "Plant parasitic fungi," "Mycoses and macrofungal poisonings of domestic and native animals," and "Human mycoses." The latter two chapters deal with many of the same groups of fungi and types of infections and could have been profitably combined. Similarly, "Fungal toxins and animals" and "Fungi and mycotoxins in food" discuss overlapping groups of fungi and compounds. Ethnomycology is treated in "Aboriginal knowledge and use of fungi" and "Macrofungi toxic to humans." Surprisingly, there is no chapter dedicated to mycorrhizae, although three pages are devoted to this subject in "Plant parasitic fungi."

Both parts of volume 1 include an index, a list of abbreviations, and many excellent photographs of fungi. Volume 1A also includes a glossary.

The **Fungi of Australia** series is the product of a far-sighted program that I sincerely hope will be emulated in other nations. Volume 1 succinctly reviews general topics in organismal mycology and simultaneously provides a unique and valuable introduction to Australian fungi. *D.S.H.*

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NOTICE: SIXTH INTERNATIONAL MYCOLOGICAL CONGRESS

The Sixth International Mycological Congress – IMC6 is scheduled to take place August 23-28, 1998 in Jerusalem at the ICC Jerusalem International Convention Center.

The Congress Program encompasses a wide array of themes structured of symposia sessions and workshops, daily plenary lectures, social activities and a special program for accompanying persons.

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MYCOTAXON

Volume LXII, pp. 497 April-May 1997

NOTICE: XIII CONGRESS OF EUROPEAN MYCOLOGISTS

The XIII Congress of European Mycologists will be held at the Campus of the University of Alcalá, Alcalá de Henares, Madrid, Spain from Tuesday the 21st to Saturday the 25th of September, 1999.

Organising & Scientific Committee

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Page 292, line 16	*for* Zimbabwi	*read* Ethiopia

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Page 87, line 2	*for* Volume LXII	*read* Volume XXI

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Page 290, line 26	*for* Boedinopeziza	*read* Boedijnopeziza
Page 282, line 16	*for* spongiosum	*read* spongiosa
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Author Index, Volume Sixty-two

Abbott, Sean P., and R. S. Currah. The Helvellaceae: systematic revision and occurrence in northern and northwestern North America, **62:** 1-125. 1997.

Abraham, T. K., *see* **Vrinda & al.**

Akers, Brian P., and Walter J. Sundberg. *Leucoagaricus hortensis*: some synonyms from Florida and taxonomic observations, **62:** 401-419. 1997.

Albertó, Edgardo, and Jorge E. Wright. Aniline agar: a simple medium useful in characterizing white-rot higher fungi in culture, **62:** 375-388. 1997.

Anon. Notice: Sixth International Mycological Congress, **62:** 495. 1997.

Anon. Notice: XIII Congress of European Mycologists, **62:** 497. 1997.

Bessette, Alan E., *see* **Desjardin and Bessette.**

Checa, J. Annotated list of the Hysteriaceae (Dothideales, Ascomycotina) reported from the Iberian Peninsula and Balearic Islands, **62:** 349-374. 1997.

Currah, R. S., *see* **Abbott and Currah.**

De, A. B. A new species of *Puccinia* from India, **62:** 337-340. 1997.

Desjardin, Dennis E., and Alan E. Bessette. A new *Mycena* from New York, **62:** 299-303. 1997.

Din, Laily B., *see* **Elix & al.**

Elix, John A., Laily B. Din, and Ghazally Ismail. New species and combinations in the lichen genus *Parmotrema* (Ascomycotina, Parmeliaceae) from Malaysia and Papua New Guinea, **62:** 341-347. 1997.

Esteve-Raventós, F. Studies on the genus *Inocybe* in the Iberian Peninsula and Balearic Islands. II. *Inocybe catalaunica*, **62:** 421-425. 1997.

Esteve-Raventos, F., *see* **Moreno & al.**

Estrada-Torres, Arturo, *see* **Hernández-Cuevas and Estrada-Torres.**

Gardner, Donald E. *Septoria vulcani* sp. nov. on endemic *Rumex* in Hawai'i, **62:** 461-464. 1997.

Gerber, Alexandra Lehmkuhl, and Clarice Loguercio-Leite. New records of polypores (Aphyllophorales) from southern Brazil, **62:** 305-318. 1997.

Giralt, Mireia, and Xavier Llimona. The saxicolous species of the genera *Rinodina* and *Rinodinella* lacking spot test reactions in the Iberian Peninsula, **62:** 175-224. 1997.

Gilbertson, Robert L., and Don E. Hemmes. Notes on fungi on Hawaiian tree ferns, **62:** 465-487. 1997.

Goos, R. D. On some infrequently encountered fungi collected in Rhode Island, USA, **62:** 395-400. 1997.

Hemmes, Don E., *see* **Gilbertson and Hemmes**

Hernández-Cuevas, Laura, and Arturo Estrada-Torres. Mexican Didymiaceae (Myxomycetes, Order Physarales): three new records and comments on *Mucilago crustacea*, **62:** 319-335. 1997.

Heykoop, M., *see* **Moreno & al.**

Hibbett, D. S. Book Reviews, **62:** 489-493. 1997.

Horak, Egon, and Orson K. Miller, Jr. A new species of *Simocybe* from North America, **62:** 225-229. 1997.

Huhtinen, Seppo, *see* **Raitviir and Huhtinen**

Ismail, Ghazally, *see* **Elix & al.**

Kirchmair, M., *see* **Moreno & al.**

Kong, Hua-zhong. *Stachybotrys yunnanensis* sp. nov. and *Neosartorya delicata* sp. nov. isolated from Yunnan, China, **62:** 427-433. 1997.

Levetin, Estelle, *see* **Portman & al.**

Loguercio-Leite, Clarice, *see* **Gerber and Loguercio-Leite**

Miller, Orson K., Jr., *see* **Horak and Miller.**

Moreno, G., R. Pöder, M. Kirchmair, F. Esteve-Raventos, and M. Heykoop. *Dermocybe cistoadelpha*, a new species in the section *Sanguineae* from Spain, **62:** 239-246. 1997.

Moreno, G., *see* **Pöder & al.**

Moseman, Rowena, *see* **Portman & al.**

Llimona, Xavier, *see* **Giralt and Llimona.**

Pöder, R., G. Moreno, M. Tabarés, and A. Rocabruna. A new *Boletellus* from Catalonia (Spain), **62:** 231-237. 1997.

Pöder, R., *see* **Moreno & al.**

Portman, Richard, Rowena Moseman, and Estelle Levetin. Ultrastructure of basidiospores in North American members of the genus *Calvatia*, **62:** 435-443. 1997.

Pradeep, C. K., *see* **Vrinda & al.**

Raitviir, Ain, and Seppo Huhtinen. Glassy-haired Hyaloscyphaceae: new taxa and new synonymies, **62:** 445-460. 1997.

Rocabruna, A., *see* **Pöder & al.**

Seidl, Michelle T., *see* **Tavares & al.**

Sundberg, Walter J., *see* **Akers and Sundberg**

Tabarés, M., *see* **Pöder & al.**

Tang, Hsi-Chang, *see* **Tavares & al.**

Tavares, Isabelle I., Michelle T. Seidl, and Hsi-Chang Tang. Fungal and lichenological types in the University Herbarium, University of California at Berkeley (UC) – a partial listing, **62:** 247-288. 1997.

Vánky, Kálmán. Taxonomical studies on Ustilaginales. XV, **62:** 127-150. 1997.

Vánky, Kálmán. New Ustilaginales from Australia, **62:** 151-174. 1997.

Vrinda, K. B., C. K. Pradeep, and T. K. Abraham. A new species of *Russula* from Kerala, India, **62:** 389-393. 1997.

Wang, Zheng. Taxonomy of *Cookeina* in China, **62:** 289-298. 1997.

Wright, Jorge E., *see* **Albertó and Wright.**

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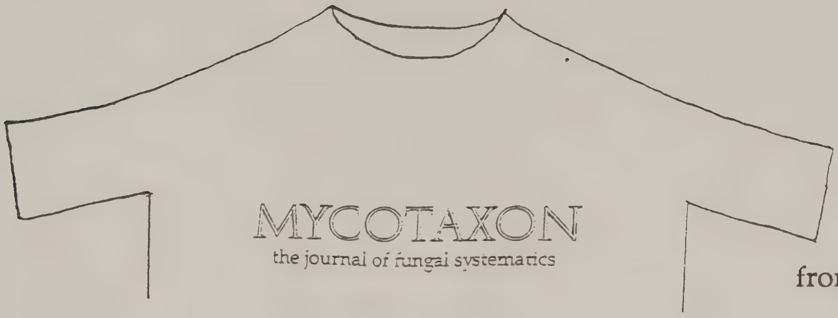
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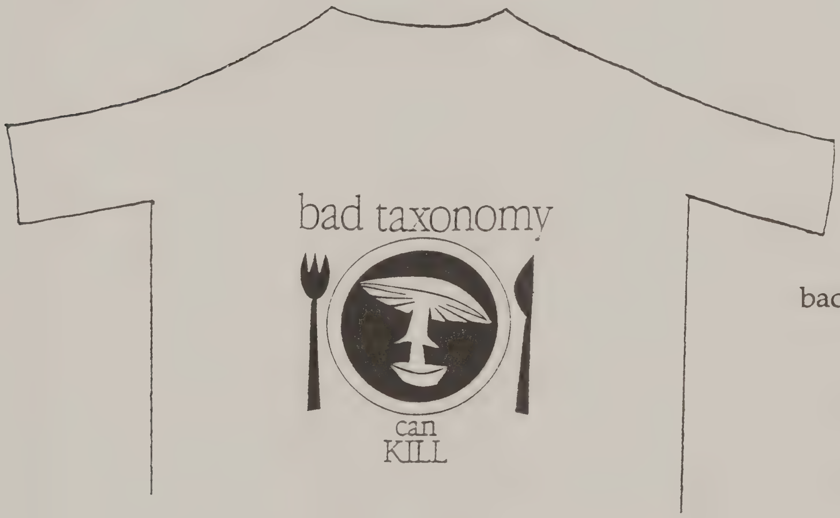

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